Horticultural, Landscape, and Ornamental Crops

Christmas Tree Plantation Pests

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In all cases, follow the instructions on the pesticide label. The *PNW Insect Management Handbook* has no legal status, whereas the pesticide label is a legal document. Read the product label before making *any* pesticide applications.

Notes

1. Product names are listed as examples only. There may be numerous product options for some active ingredients.
2. Experience has shown that use of pyrethroid insecticides is associated with subsequent spider mite outbreaks. Therefore, monitor fields closely after using these materials.
3. Check current label for application options (i.e., aerial vs. ground only, restrictions, re-entry intervals, pollinator safety, groundwater and stream buffer requirements, application timing, etc.)
4. To avoid resistance, growers are advised to not use repeated application of the same active ingredient or repeated use of chemicals in the same mode of action group.

Note: Products are listed in alphabetical order and not in order of preference or superiority of pest control.

Pests common to Douglas-fir, True Fir, Pine and Spruce

Christmas tree (Common pests)—Conifer aphid

Cinara occidentalis and *Cinara abietis*

Pest description and crop damage *C. abietis* are large, dark aphids typically feeding on upper stems and tended by ants. May distort stems. *C. occidentalis* feed at the base of needles on 1 year and older foliage, often in the lower portion of the tree and may be quite damaging.

See table:
Hosts and Symptoms of Major Aphid and Adelgid Pests of Christmas Trees

Management—cultural control

C. abietis is easily spotted and often controlled by squishing colonies by hand or spot spraying. Minor outbreaks of both species may be kept in check with beneficial insect predators or spot treatments.

Management—chemical control

- afidopyropen (Ventigra) (Subgroup 9D)—Not permitted in Oregon
- azadirachtin (AzaDirect and others)—Some formulations are OMRI-listed for organic use.

- bifenthrin (OnyxPro, Sniper and others) (Group 3)—Restricted use pesticide
- *Chromobacterium subtsugae* (Grandevo)—OMRI-listed for organic use.
- cyantraniliprole (Mainspring GNL, Exirel) (Group 28)
- cyclaniliprole + flonicamid (Pradia) (Group 28 + Group 29)
- dinotefuran (Safari 20 SG) (Group 4A)
- flupyradifurone (Sivanto Prime) (Group 4D)
- imidacloprid (Montana, Nuprid 4F and others) (Group 4A)
- insecticidal soaps and oils (Ecotec, M-pede, 440 Superior Oil, Ultra-Pure Oil and others)—Test for phytotoxicity for any new oil product prior to widespread use. Some formulations are OMRI-listed for organic use.
- malathion (organophosphate) (various formulations) (Group 1B)
- pymetrozine (Endeavor and others) (Group 9)
- spirotetramet (Ultor, Movento) (Group 23)
- sulfoxaflor (Transform WG) (Group 4C)
- thiamethoxam (Flagship 25 WG) (Group 4A)

Management—biological control

- aphid predators (*Aphidoletes aphidimyza*, *Aphidius* spp., *Hippodamia* spp., *Chrysopa* spp.)—Consider attracting predators with forage plantings and using products with low toxicity to predators.

See:

Biological Control of Nursery Pests

Christmas tree (Common pests)—Eriophyid needle mite

Epitrimeris spp. and others

Pest description and crop damage Very tiny, white, worm-shape mites found along stem and needle bases. Infested foliage takes on an olive-green color; older needles drop prematurely.

Management—chemical control

Biology and distribution of this mite is not well understood. Apply when new growth is 1 inch or less.

- abamectin (Avid, Minx and others) (Group 6)
- carbaryl (Sevin and others) (Group 1A)
- fenazaquin (Magister and others) (Group 21)
- fenpyroximate (Akari 5SC) (Group 21)
- horticultural oil (Omni Supreme, 440 Superior Oil, Ultra-Pure Oil and others)—Test for phytotoxicity for any new product prior to widespread use. Some formulations are OMRI-listed for organic production.
- spirodiclofen (Envidor) (Group 23)

Christmas tree (Common pests)—Root weevil (adult)

Strawberry root weevil (*Otiorhynchus ovatus*) and others

Pest description and crop damage Larvae are cream-colored, C-shaped grubs that feed on roots, sometimes girdling them. Adults feed on Douglas-fir and true fir needles, resulting in characteristic notching.

Management—cultural control

Site preparation with fallow period prior to planting will reduce habitat for weevils.

Management—chemical control

Control typically targets adult feeding at emergence.

- bifenthrin (OnyxPro, Sniper and others) (Group 3)—Restricted use pesticide
- cyclaniliprole (Sarisa) (Group 28)
- cyclaniliprole + flonicamid (Pradia) (Group 28 + Group 29)
- dinotefuran (Safari 20 SG) (Group 4A)
- esfenvalerate (Asana XL and others) (Group 3)—Restricted use pesticide
- thiamethoxam (Flagship 25 WG) (Group 4A)

Christmas tree (Common pests)—Spider mite

Oligonychus ununguis and others

Pest description and crop damage Dark green mite stipples and bronzes needles, beginning at the base. Overwinters as red-orange eggs.

Management—chemical control

- abamectin (Avid, Minx and others) (Group 6)
- azadirachtin (AzaDirect and others)—Some formulations are OMRI-listed for organic production.
- bifenazate (Acramite 4SC, Floramite SC, and others) (Group 20)
- bifenthrin (OnyxPro, Sniper and others) (Group 3)—Restricted use pesticide.
- *Chromobacterium subtsugae* (Grandevo)—OMRI-listed for organic use.
- clofentezine (Apollo SC and others) (Group 10)
- etoxazole (TetraSan 5 WDG and others) (Group10)
- fenazaquin (Magistar and others) (Group 21)
- fenbutatin-oxide (Vendex and others) (Group12b)—Restricted use pesticide.
- fenpyroximate (Akari 5 SC and others) (Group 21)
- hexythiazox (Onager, Hexygon, Savey) (Group 10)
- insecticidal soaps and oils (Ecotec, Captiva, M-pede, Ultra-Pure Oil, 440 Superior [Winter only] and others)—Test for phytotoxicity for any new oil product prior to widespread use. Some formulations are OMRI- listed for organic production.
- malathion (organophosphate) (various formulations) (Group 1B)
- propargite (Omite-30WS, Omite 6E) (Group 12)—Restricted use pesticide
- spinosad (Blackhawk, Conserve, Entrust and others) (Group 5)
- spirodiclofen (Envidor) (Group 23)

Management—biological control

Predatory mites (*Neoseiulus* spp., *Phytoseilulus* spp. and others)—Note: Little is known regarding controlled releases; yet control in plantations from native populations is common.

See:
Biological Control of Nursery Pests

Christmas tree (Common pests)—Spruce budworm

Choristoneura fumiferana

Pest description and crop damage Green-brown larvae up to 1 inch long feed on foliage and buds of fir, spruce, and Douglas-fir.

Management—chemical control

Apply May–June or when bud flush is at 90 to 95% and new growth is 0.75 to 1 inch. Pay particular attention to areas adjacent to infested forest. Two applications may be necessary.

- carbaryl (Sevin and others) (Group 1A)
- *Burkholderia* spp. (Venerate) – OMRI-listed for organic production.
- *Chromobacterium subtugae* (Grandevo)—OMRI-listed for organic production
- esfenvalerate (Asana XL and others) (Group 3)—Restricted use pesticide
- methoxyfenozide (Intrepid 2F) (Group 18)
- spinosad (Blackhawk, Conserve, Entrust and others) (Group 5)—Some formulations are OMRI-listed for organic production
- tebufenozide (Confirm) (Group 18)

Christmas tree—Twig weevil

Cylindrocopturus furnissi

Pest description and crop damage Small gray-black weevil with white mottling, sometimes with pink or orange spots. It may kill small branches and sometimes small trees. Traditionally thought to infest only Douglas-fir, yet has been found on various true firs as well in recent years including Nordmann, noble and Turkish firs.

Management—cultural control

Keep trees healthy. Remove and burn infested twigs. Avoid planting on drought-prone or wet sites. Frequently, cultural control provides the only practical option available.

Management—chemical control

- bifenthrin (OnyxPro, Sniper and others) (Group 3)—Restricted use.
- esfenvalerate (Asana XL and others) (Group 3)—Restricted use pesticide.

Christmas tree (Common pests)—White grub

Includes
Ten-lined June beetle (*Polyphylla decemlineata*)
Rain beetle (*Plecoma* spp.)
Aphodius spp.

Pest description and crop damage Small to large C-shaped, white scarab beetle larva with six legs and a brown head. Grubs feed on roots, often killing young trees. Many follow the soil moisture and may appear absent in summer.

Management—biological control

Some growers have observed partial control from parasitic nematodes, but results are poorly replicated.

Management—chemical control

To date, chemical control on established large grub populations has not been effective.

- bifenthrin (OnyxPro, Sniper and others) (Group 3)—Restricted use pesticide.
- carbaryl (Sevin and others) (Group 1A)
- cyantraniliprole (Mainspring GNL) (Group 28)
- imidacloprid (Montana, Nuprid 2F and others) (Group 4A)
- thiamethoxam (Flagship 25 WG) (Group 4A)

Douglas-fir

Christmas tree (Douglas-fir)—Black pineleaf scale

Nuculaspis californica

Pest description and crop damage Gray-black scale. Hosts: Douglas-fir and pine.

Management—chemical control

- azadirachtin (AzaDirect and others)—Some formulations are OMRI-listed for organic production.
- bifenthrin (OnyxPro, Sniper and others) (Group 3)—Restricted use pesticide
- buprofezin (Talus and others) (Group 16)
- dinotefuran (Safari 20 SG) (Group 4A)
- horticultural oil (Ultra-Pure, 440 Superior Oil and others)—Test for phytotoxicity for any new product prior to widespread use. Some formulations are OMRI-listed for organic production.

Christmas tree (Douglas-fir)—Coneworm

Dioryctria spp.

Pest description and crop damage Small creamy-brown moth larvae bore into stems, especially around wounds.

Management—chemical control

Applications must be made before eggs hatch and larvae tunnel into stem. Using pyrethroid insecticides is associated with subsequent spider mite outbreaks.

- carbaryl (Sevin and others) (Group 1A)
- esfenvalerate (Asana XL and others) (Group 3A)—Restricted use pesticide.
- phosmet (Imidan 70W) (Group 1B)
- spinosad (Blackhawk, Conserve, Entrust and others) (Group 5)—Some formulations are OMRI-listed for organic production.

Christmas tree (Douglas-fir)—Cooley spruce gall adelgid

Adelges cooleyi

Pest description and crop damage Adelgids appear as small cottony tufts on underside of needles. May cause yellowing, distortion, and premature needle drop. Aphids may distort stems.

See table:
Hosts and Symptoms of Major Aphid and Adelgid Pests of Christmas Trees

Management—chemical control

Apply to control crawler stage, usually when new growth is expanding in spring.

- bifenthrin (OnyxPro, Sniper and others) (Group 3)—Restricted use pesticide.

- carbaryl (Sevin and others) (Group 1A)
- cyantraniliprole (Mainspring GNL) (Group 28)
- cyclaniliprole (Sarisa and others) (Group 28)
- cyclaniliprole + flonicamid (Pradia) (Group 28 + Group 29)
- dinotefuran (Safari 20 SG) (Group 4A)
- imidacloprid (Montana, Nuprid 4F and others) (Group 4A)
- insecticidal soap (M-Pede and others)—Some formulations are OMRI-listed for organic production.
- spirotetramat (Ultor, Movento) (Group 23)
- thiamethoxam (Flagship 25 WG) (Group 4A)

Christmas tree (Douglas-fir)—Douglas-fir needle midge

Contarinia spp.

Pest description and crop damage Adult is a small midge (fly). Larvae mine needles; they often appear as a purple node above which the needles are distorted. Degree day models and traps are available to monitor pest emergence.

Management—chemical control

Time applications based on adult needle midge trap catch. Time to coincide with adult emergence.

- acephate (Acephate 97 and Bracket) (Group 1B)
- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use
- cyclaniliprole+ flonicamid (Pradia) (Group 28 + Group 29)
- thiamethoxam (Flagship 25 WG) (Group 4A)

Christmas tree (Douglas-fir)—Pine needle scale

Chionaspis pinifoliae

Pest description and crop damage White scale flock needles. Hosts: Douglas-fir and pines. Eggs hatch May or June, perhaps July.

Management—chemical control

Apply to crawler stage.

- azadirachtin (AzaDirect and others)—Some formulations are OMRI-listed for organic production.
- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use pesticide
- buprofezin (Talus and others) (Group 16)
- dinotefuran (Safari 20 SG) (Group 4A)
- horticultural oil/soap (M-Pede, Ultra-Pure, 440 Superior Oil and others)—Test for phytotoxicity for any new oil product prior to widespread use. Some formulations are OMRI-listed for organic production.
- sulfoxaflor (Transform WG) (Group 4C)

Christmas tree (Douglas-fir)—Tussock moth

Includes
Douglas-fir tussock moth (*Orgyia pseudotsugata*)
Rusty tussock moth (*Orgyia antiqua nova*)

Pest description and crop damage Caterpillars with tufts (tussocks) of hair. Larvae may be found in large numbers under webbing on branches.

Management—chemical control

Apply to control young larvae when present and feeding.

- *Chromobacterium subtsugae* (Grandevo)—OMRI-listed for organic use.
- spinosad (Blackhawk, Conserve, Entrust and others) (Group 5)—Some formulations are OMRI-listed for organic production.
- tebufenozide (Confirm) (Group 18)

Christmas tree (Douglas-fir)—White pine weevil

Pissodes strobi

Pest description and crop damage A small brown weevil, roughly 0.25 inch in length, with the snout typical of other weevils. Wing covers are marked with irregular patches of brown and white scales. Important pest of spruce and pine, occasionally a pest of Douglas-fir.

Management—chemical control

Apply to the tops to control egg-laying weevils as weather warms in spring. Several applications 3 to 4 weeks apart may be necessary.

- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use
- phosmet (Imidan 70W) (Group 1B)

Pine

Christmas tree (Pine)—Black pineleaf scale

Nuculaspis californica

Management—chemical control

- azadirachtin (AzaDirect and others)—Some formulations are OMRI-listed for organic production.
- dinotefuran (Safari 20 SG) (Group 4A)
- horticultural oil/soap (M-Pede and others)—Test for phytotoxicity for any new oil product prior to widespread use. Some formulations are OMRI-listed for organic production.
- sulfoxaflor (Transform WG) (Group 4C)

Christmas tree (Pine)—Coneworm

See:
Christmas tree (Douglas-fir)—Coneworm

Christmas tree (Pine)—European pine shoot moth

Rhyacionia buoliana

Pest description and crop damage Larvae stunt and deform stems, especially terminals. The moth is established in western Washington but still relatively rare in Oregon.

Sampling and thresholds Pheromone traps and degree-day models are available to monitor for adults.

Management—chemical control

Time applications to coincide with adult emergence.

- carbaryl (Sevin and others) (Group 1A)
- phosmet (Imidan 70W) (Group 1B)
- spinosad (Blackhawk, Conserve, Entrust and others) (Group 5)—Some formulations are OMRI-listed for organic production.
- tebufenozide (Confirm) (Group 18)

Christmas tree (Pine)—Pine bark adelgid

Pinus strobi

Pest description and crop dam Appear as white, woolly mass on trunk or stem. May severely distort new growth.

See table:
Hosts and Symptoms of Major Aphid and Adelgid Pests of Christmas Trees

Management—chemical control

- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use pesticide
- cyantraniliprole (Mainspring GNL) (Group 28)
- cyclaniliprole (Sarisa and others) (Group 28)
- cyclaniliprole + flonicamid (Pradia) (Group 28 + Group 29)
- dinotefuran (Safari 20 SG) (Group 4A)
- imidacloprid (Montana, Nuprid 4F and others) (Group 4A)—Apply to control crawler stage around bud break.
- thiamethoxam (Flagship 25 WG) (Group 4A)

Christmas tree (Pine)—Pine needle scale

Chionaspis pinifoliae

Pest description and crop damage White scale flock needles. Hosts: Douglas-fir and pines. Eggs hatch May or June, perhaps July.

Management—chemical control

Apply to crawler stage.

- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use pesticide

- dinotefuran (Safari 20 SG) (Group 4A)
- horticultural oil/soap (M-Pede, Ultra-Pure Oil and others)—Test for phytotoxicity for any new oil product prior to widespread use. Some formulations are OMRI-listed for organic production.
- sulfoxaflor (Transform WG) (Group 4C)

Christmas tree (Pine)—White pine weevil

Pissodes strobi

Pest description and crop damage A small brown weevil, roughly 0.25-inch-long, with the snout typical of other weevils. Wing covers have irregular patches of brown and white scales. Important pest of spruce and pine, occasionally a pest of Douglas-fir.

Management—chemical control

Apply to the tops to control egg-laying weevils as weather warms in spring. Several applications 3 to 4 weeks apart may be necessary.

- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use pesticide
- phosmet (Imidan 70W) (Group 1B)

Spruce

Christmas tree (Spruce)—Cooley spruce gall adelgid

Adelges cooleyi

Pest description and crop damage Causes "pineapple" galls on spruce, the primary host.

See table:
Hosts and Symptoms of Major Aphid and Adelgid Pests of Christmas Trees

Management—chemical control

Apply to control crawler stage, usually when new growth is expanding in spring.

- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use pesticide
- cyantraniliprole (Mainspring GNL) (Group 28)
- cyclaniliprole (Sarisa and others) (Group 28)
- cyclaniliprole + flonicamid (Pradia) (Group 28 + Group 29)
- dinotefuran (Safari 20 SG) (Group 4A)
- imidacloprid (Montana, Nuprid 4F and others) (Group 4A)
- spirotetramat (Ultor, Movento) (Group 23)
- thiamethoxam (Flagship 25 WG) (Group 4A)

Christmas tree (Spruce)—Spruce aphid

Elatobium abietinum

Pest description and crop damage Small, dull-green aphid causes extreme needle drop. Aphids appear early in the season (fall to winter months) and may increase rapidly during March and April.

See table:
Hosts and Symptoms of Major Aphid and Adelgid Pests of Christmas Trees

Management—biological control

This aphid eludes most predators except the brown lacewing.

Management—chemical control

- afidopyropen (Ventigra) (Group 9D)—Not permitted in Oregon
- azadirachtin (AzaDirect and others)—Some formulations are OMRI-listed for organic production.
- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use pesticide
- cyantraniliprole (Mainspring GNL) (Group 28)
- cyclaniliprole + flonicamid (Pradia) (Group 28 + Group 29)
- dinotefuran (Safari 20 SG) (Group 4A)
- flupyradifurone (Sivanto Prime) (Group 4D)
- imidacloprid (Montana, Nuprid 4F and others) (Group 4A)
- insecticidal soaps and oils (Ecotec, M-pede, Ultra-Pure Oil and others)—Some formulations are OMRI-listed for organic production. Note: Some oils may discolor blue spruce. Test for phytotoxicity for any new oil product prior to widespread use.

- pymetrozine (Endeavor and others) (Group 9)
- spirotetramat (Ultor, Movento) (Group 23)
- sulfoxaflor (Transform WG) (Group 4C)
- thiamethoxam (Flagship 25 WG) (Group 4A)

Christmas tree (Spruce)—White pine weevil

Pissodes strobi

Pest description and crop damage A small brown weevil, roughly 0.25 inch in length, with the "snout" typical of other weevils. Wing covers have irregular patches of brown and white scales. Important pest of spruce and pine, occasionally a pest of Douglas-fir.

Management—chemical control

Apply to the tops to control egg-laying weevils as weather warms in spring. Several applications 3 to 4 weeks apart may be necessary.

- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use pesticide
- phosmet (Imidan 70W) (Group 1B)

True Fir

Christmas tree (True fir)—Balsam twig aphid

Mindarus abietinus

Pest description and crop damage Small, yellow-green aphids with woolly exudates attack new terminals.

See table:

Hosts and Symptoms of Major Aphid and Adelgid Pests of Christmas Trees

Management—chemical control

- afidopyropen (Ventigra) (Group 9D)—Not permitted in Oregon
- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use pesticide
- carbaryl (Sevin and others) (Group 1A)
- cyantraniliprole (Mainspring GNL) (Group 28)
- cyclaniliprole + flonicamid (Pradia) (Group 28 + Group 29)
- dinotefuran (Safari 20 SG) (Group 4A)
- esfenvalerate (Asana XL and others) (Group 3A)—Restricted use pesticide.
- flupyradifurone (Sivanto Prime) (Group 4D)
- imidacloprid (Montana, Nuprid 4F and others) (Group 4A)
- insecticidal soaps and oils (Ecotec, M-pede, Ultra-Pure Oil, 440 Superior Oil, and others)—Some formulations are OMRI-listed for organic production. Note: Some oils may cause discoloration. Test for phytotoxicity for any new oil product prior to widespread use.
- pymetrozine (Endeavor and others) (Group 9)
- spirotetramat (Ultor, Movento) (Group 23)
- sulfoxaflor (Transform WG) (Group 4C)
- thiamethoxam (Flagship 25 WG) (Group 4A)

Management—biological control

- aphid predators (*Aphidoletes aphidimyza*, *Aphidius* spp., *Hippodamia* spp., *Chrysopa* spp.)—Consider attracting predators with forage plantings as keeping some species of predators on-site has challenged growers.
- *Beauveria bassiana* (BotaniGard ES)

See:

Biological control of Nursery Pests

Christmas tree (True fir)—Balsam woolly adelgid

Adelges piceae

Pest description and crop damage Appear as cottony or grayish mass on stems. They produce swelling at nodes and tips and are especially damaging to Fraser fir.

See table:

Hosts and Symptoms of Major Aphid and Adelgid Pests of Christmas Trees

Management—chemical control

Apply to control crawler stage around bud break, usually mid-April to early May.

- bifenthrin (OnyxPro, Sniper and others) (Group 3A)—Restricted use pesticide
- cyantraniliprole (Mainspring GNL) (Group 28)
- cyclaniliprole (Sarisa and others) (Group 28)
- cyclaniliprole + flonicamid (Pradia) (Group 28 + Group 29)
- dinotefuran (Safari 20 SG) (Group 4A)
- esfenvalerate (Asana XL and others) (Group 3A)—Restricted use pesticide
- imidacloprid (Montana, Nuprid 4F and others) (Group 4A)
- insecticidal soap/oil (M-Pede)—Some formulations are OMRI-listed for organic production. Note: Some oils may cause discoloration. Test for phytotoxicity for any new oil product prior to widespread use.
- spirotetramat (Ultor, Movento) (Group 23)
- thiamethoxam (Flagship 25 WG) (Group 4A)

Christmas tree (True fir)—Conifer root aphid

Prociphilus americanus

Pest description and crop damage Tree above ground is stunted and off-color. Below ground colonies of white aphids attached to roots often tended by small ants. In severe cases, replanting may be required as unhealthy trees are slow to recover.

See table:
Hosts and Symptoms of Major Aphid and Adelgid Pests of Christmas Trees

Management—chemical control

- spirotetramat (Ultor, Movento) (Group 23)—Appropriate surfactant necessary.
- thiamethoxam (Flagship 25 WG) (Group 4A)

Christmas Tree Export Pests

Many insects have export restrictions, but the pests listed below do not cause tree damage so are listed separately.

Christmas tree (Export pests)—Slug and snail

Various species

Pest description and crop damage There is no crop damage, but slugs and snails are hitchhiking pests that are restricted at a number of export destinations.

Management—cultural control

Shaking prior to loading will remove some. Minimizing the time trees are in contact with the ground prior to shipping will help limit numbers. Placing trees on pallets and using tarps should help.

Management—chemical control

- iron phosphate/spinosad (Bug-N-Sluggo) may be used in fields and on landings. (Group 5)
- metaldehyde baits (Deadline Bullet and others) may be used in landings and right-of-way areas. Lock Out Slug Bait may be used in plantations and on landings in Oregon only.

Christmas tree (Export pests)—German yellowjacket

Vespula germanica

Pest description and crop damage German yellow jacket is an extremely rare hitchhiking pest and restricted in a number of export destinations. Adults have yellow and black marks with a spade shape on the 1st abdominal segment and black spots down the sides of the 2nd to 5th segments. Easily confused with common yellow jacket.

Management—cultural control

Shaking prior to loading will remove some yellow jackets.

During harvest, close doors on trailers when not loading and place netting over stacks of trees in loading sites.

Management—chemical control

Spot treating nests with aerosol sprays and trapping with heptyl-butyrate traps early (March) will help control yellow jackets.

Christmas tree (Export pests)—Exports to Mexico

Management—chemical control

The regulations for tree imports into Mexico are prescriptive and state: "A pesticide treatment is required 3 to 6 weeks prior to harvest using one of the following insecticides: permethrin at 36.8% active ingredient (ai), esfenvalerate at 8.4% ai or bifenthrin at 7.9% ai in accordance with doses recommended on the label." Check export regulations at harvest time as these may be phased out.

The pesticide label must also allow for the use of the product on Christmas trees. Three esfenvalerate products meet both the ai and registration components of these rules:

- esfenvalerate (8.4%) (Group 3A)
- Asana XL (Valent), EPA Reg. No. 59639-209Zyrate (Rotam NA), EPA Reg. No. 71532-21-83979
- S-FenvaloStar (LG International), EPA Reg. No. 71532-21-91026

Hosts and Symptoms of Major Aphid and Adelgid Pests of Christmas Trees

Tree and symptoms	Pest
Douglas-fir (*Pseudotsuga*)	
Aphids without much waxy covering. Producing large amounts of honeydew, which may be attractive to ants and yellow jackets, or covered by sooty mold.	conifer aphid (*Cinara* spp.)
"Pepper" flecks (crawlers) on needles in late spring and/or white cottony tufts on needles before budbreak or after about mid-June.	Cooley spruce gall adelgid (*Adelges cooleyi*)
True fir (Abies)	
Aphids without much waxy covering. Producing large amounts of honeydew, which may be attractive to ants and yellow jackets, or covered by sooty mold. Two species, *C. occidentalis* and *C. abietis*, are found in noble fir. The former is found typically on the tree bases on 1 to 3 year old branches and can be quite damaging, the latter is a large conspicuous aphid found on the leaders throughout the year.	conifer aphid (*Cinara* spp.)
Swelling of branch nodes. Very small waxy adelgids may or may not be found. Trunk, branches, or twigs may be covered with white, waxy secretions in heavy infestations.	balsam woolly adelgid (*Adelges piceae*)
Twisting of new growth. Small greenish yellow or bluish gray aphids. Wax and honeydew may be present, matting needles together.	balsam twig aphid (*Mindarus abietinus*)
Tree above-ground appears stunted and off-color. Below ground there may be colonies of white colored aphids feeding on roots, often tended by ants.	conifer root aphid (*Prociphilus americanus*)
Spruce (Picea)	
Aphids without much waxy covering. Producing large amounts of honeydew, which may be attractive to ants and yellow jackets, or covered by sooty mold.	conifer aphid (*Cinara* spp.)
Pineapple-shape galls or cones on branch tips	Cooley spruce gall adelgid (*Adelges cooleyi*)
Twisting of new growth. Small greenish yellow or bluish gray aphids. Wax and honeydew may be present as well.	balsam twig aphid (*Mindarus abietinus*)

Old (more than 1 year old) needles shed, especially on lower, shaded portions of tree. Aphids peak in late winter (February–March), decline toward summer. Small, green aphids.	spruce aphid (*Elatobium abietinum*)
Pine (*Pinus*)	
Aphids without much waxy covering. Producing large amounts of honeydew, which may be attractive to ants and yellow jackets, or covered by sooty mold.	conifer aphid (*Cinara* spp.)
White flocking on bark of branches and trunk. Trunk may appear “snow covered.”	pine bark adelgid (*Pinus strobi*)

Common Pests of Nursery Crops

John Rinehold

Latest revision—March 2021

We thank Robin Rosetta for significant contributions to previous revisions of this chapter.

In all cases, follow the instructions on the pesticide label. The *PNW Insect Management Handbook* has no legal status, whereas the pesticide label is a legal document. Read the product label before making any pesticide applications.

Protect pollinators: See How to Reduce Bee Poisoning from Pesticides.

Note: Products are listed in alphabetical order and *not* in order of preference or superiority of pest control.

Not all products listed are registered in all states.

Nursery crop pests—Aphids

Pest description and crop damage Aphids are small, soft-bodied insects with piercing-sucking mouthparts formed into a long needle-like stylet they hold under their body when not feeding. They are usually identified by host plant, and characters such as color, wing venation, antennae, and cornicles (two tubular structures on the hind section of the aphid). The same species can vary in color, shape, and size depending on the time of the year. Immature nymphs look like smaller versions of adult nymphs. Some aphid species produce waxy strands over their surface. All are soft-bodied insects with a piercing–sucking mouthpart called a stylet. Crop damage includes distorted plant growth, particularly terminals, deposition of a sweet, shiny liquid called honeydew, black sooty mold (which grows on the honeydew), waxy deposits (some species), yellowing, plant galls (on some hosts) and general plant decline. Several aphid species are also vectors of plant diseases, particularly viruses.

Biology and life history Most species of aphid have similar life cycles. Aphid females reproduce asexually through live birth most of the year. Aphid populations generally are most abundant during the cooler spring and fall seasons where populations can build up quickly. Aphids are usually found in colonies. In spring and fall, under crowded conditions, or when the nutritional quality of their host plant is reduced, aphids may produce winged adults (alates) which can disperse. In the fall, aphids mate and produce eggs for overwintering, especially in colder climates. Some species of adult aphid overwinter on crops, weeds, or trees. There may be as few as two generations or as many as 16 generations each year, depending on the species and climate. Most aphids are associated with one or several host plants. Some have alternate hosts, overwintering on one host and moving to another as the season progresses. Several species have a wide host range, with many host plants including weed species. Examples of these species include: green peach aphid (*Myzus persicae*), and cotton or melon aphid (*Aphis gossipea*). There are aphid species in the Pemphigidae, which are root aphids, that spend some of their life cycle on the root systems of their host plants such as conifers, poplars and ash.

Scouting and thresholds Monitor for aphids on at least weekly during the growing season. Scout for aphids near growing terminals near buds and fruit clusters, and leaf undersides, particularly alongside leaf veins. White cast skins, shiny honeydew, black sooty mold, and misshapen terminals are good indicators of aphid presence. Yellow sticky traps and yellow pan traps can help monitor flights of adults. Look for signs of natural enemy activity, including predators and parasites. The bodies of parasitized aphids, called mummies, will look slightly swollen brown or black, sometimes with an exit hole made by tiny wasps.

Management—biological control

See also:
Biological Control of Nursery Pests

Management—cultural control

A strong spray of water alone often effectively removes aphids. Control of associated ant species which move and protect aphids from their naturally enemies may provide additional control of the aphid populations. Aphid populations tend to be higher in plants that are fertilized liberally with nitrogen and heavily watered, as this produces flushes of succulent growth. Avoid excessive watering, and use slow-release forms or organic sources of nitrogen.

Management—chemical control

See also:

Chemical Control of Nursery Pests

There are a variety of chemical tactics available for these soft-bodied insects including relatively low toxicity contact products including soaps, oils, and botanicals. Good coverage with contact pesticides is essential. Also available are very selective chemical tools such as insect growth regulators and active ingredients with novel modes of actions such as pymetrozine (Endeavor) which disables the sucking mechanism of the aphids. Microbial pesticides such as those using the fungus *Beauveria bassiani* (Botanigard, Naturalis O) generally benefit from higher levels of humidity such as can be found during the spring and fall and in many protected systems. Systemic insecticides are particularly useful when contact is difficult and to protect new growth over time. Broad spectrum insecticides are generally less IPM compatible but may be useful when multiple types of insects must be treated.

Nursery crop pests—Leafminer

Pest description and crop damage There several different types of leafminers, including mines made by the larval stages of flies, moths, sawflies, and beetles. Damage from leafminer feeding occurs as the larvae feeds between the upper and lower epidermis of leaves or stems. Mines start as small round puncture wounds. Some mines with a long winding trail (serpentine mines) through the leaf which gradually expands. Other mines are formed as a larger feeding area called a blotch mine.

Sawflies—The adult sawfly insects are generally small thick-waisted wasps, often black and about 0.25 inch long. The larvae are small, and light colored. The larvae feed between epidermal layers, creating large dark blotches in the leaves. After the insects leave, the affected areas turn light brown and crinkle. Aside from the effects on the appearance of the foliage, some defoliation and weakening of the tree can occur.

Moth larvae—Lepidopteran larvae in the moth family Tenthredinidae are commonly leafminers. Larvae of *Phyllonorycter* species form tentiform (slightly puffed out “tent-like” mines) on many hosts including willows, poplars, apples, and hackberry. Additional moth leafminer species include lilac leafminer (*Caloptilia syringella)* and needleminers on pines.

Fly larvae—Many dipteran leafmining larvae in the fly family Agromyzidae. These include *Liomyza*, tiny yellow and black flies whose larvae mine leaves on chrysanthemums. Other dipteran leafminers include birch leafminer (*Fenusa pusilla*), and leafminers on elm, hawthorn, and alders.

Beetle larvae—An example of a beetle leafminer is the European elm flea beetle, whose larvae feeding starts as small serpentine mines later forming blotch mines.

Biology and life history

Sawflies—Adults first appear in spring, when leaves are partly formed. The females lay eggs on newly expanding leaves, after the eggs hatch they mine out the middle layer of the leaf forming a blotch mine. After 2 to 3 weeks, the larvae drop to the ground and pupate. There are normally one generation per year.

Moth larvae—Many of these leafminers have two generations per year.

Fly larvae—The female leafminer flies insert their eggs (oviposit) inside the leaves. The eggs hatch and the larvae feeds in the mines, chews a hole through the leaf, and drops to the ground to pupate.

Scouting and thresholds Monitoring should include direct observation of susceptible plants during the time the adult insects begin activity in the spring and continue on a weekly basis. Yellow sticky cards or homemade yellow sticky traps can be used to monitor for adult fly leafminers. Most leafminer damage does not impact plant health but may affect marketability.

Management—biological control

Naturally occurring parasitic wasps lay their eggs on or near the larvae in the mines. The larvae from the eggs feed on the leafminer.

Management—cultural control

Removal and destruction of mined leaves can reduce pressure.

Management—chemical control

Most sprays are timed to coincide with egg laying by the adult insects, usually on newly expanding leaves. Some control of fly and beetle larvae within mines can be achieved with systemic insecticides such as the neonicotinoids.

See also:

Chemical Control of Nursery Pests

Nursery crop pests—Scale

Pest description and crop damage There are two types of scale commonly encountered: hard scale and soft scale. Hard scale tend to be fairly small in size and lie flatter against the stems than do soft scale. Soft scale is often very rounded and will also produce honeydew with its associated black sooty mold. Scale may have only one or multiple generations per year. Scale often comes into nurseries on propagation material. This example shows the importance of inspections and sometimes, quarantine of any new plant material brought into the nursery. Early infestations can often be rogued or pruned out.

Biology and life history The life history varies with species, so species identification is needed to determine life cycle. Generally, scale overwinter as eggs or as an immature scale on twigs and branches. If scale overwinter as an immature, they resume feeding in the spring, and eggs are laid later in spring. If scale overwinter as eggs, these hatch in spring, and the young scale (called "crawlers") migrate through the foliage to feed on the leaves. Most scale insects are female. Mature females are wingless and often secrete a hard shell-like covering for protection. The males are rare, small, non-feeding, and short-lived but look more like other insects as they have wings. With a few notable exceptions, the first immature stage, or the first "instar" females are generally the only stage that disperses on plant material. All other stages remain attached to the plant surface, sessile. Females lay eggs or crawlers under their secreted scale covering or in a cavity under their bodies.

Scouting and thresholds Look for scale along stems and leaf undersides. Inspect twigs during the dormant season for scale. Pay particular attention to weak plants. The crawlers are best observed starting in spring with a 10X magnifying glass. Double-sided sticky tape can be used to check for emerging scale crawlers.

Management—biological control

Check for presence of holes in the scale covers indicating parasitic wasp activity. Ants, fond of honeydew, will fight off scale natural enemies to protect the source. Control of ants may increase biological control. There are several naturally occurring lady beetles that specialize as natural enemies of scale including *Chilocorus* and *Rhizobius*. Larvae of green lacewings and other insects are aggressive predators of scale. However, biological control will not necessarily prevent significant scale infestations.

Avoid use of broad spectrum insecticides to preserve natural enemies.

Management—cultural control

Closely inspect all incoming plant material and plants used for propagation. Pruning and rouging may be an effective tactic in the landscape or on a limited number of nursery plants. As with aphids, avoid excessive nitrogen fertilizer, as this favors population increase. Control associated ant species as they move scale and protect them from natural enemies.

Management—chemical control

Scale pests are best controlled at the "crawler" stage: the immature, active stage when the insects are most sensitive to insecticides. Spray applications should be timed to coincide with emergence of the vulnerable crawlers. Another tactic is application of systemic insecticides that are drawn into the plant, managing multiple feeding stages of the scale. Time may be needed for some plants to translocate the insecticide to infested parts of the plant. Systemic insecticides are used against many scale species but generally have been less successful with hard scales and pit scales.

Dormant-season oil spray—Apply with enough water to cover the entire tree thoroughly.

See also:

Chemical Control of Nursery Pests

For more information

PNW Nursery IPM: A Matter of Scale (http://oregonstate.edu/dept/nurspest/scale.htm)

WSU Extension Bulletin: EB1552E: Scale Insects on Ornamentals
(http://cru.cahe.wsu.edu/CEPUBLICATIONS/EB1552E/EB1552E.PDF)

Nursery crop pests—Spider mite

Pest description and crop damage Several species of spider mites can cause damage in deciduous ornamentals. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Mites damage plants by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor. The most common pest species of spider mite on conifers is

spruce spider mite. It can cause damage on a wide range of conifers. Adults and nymphs can be yellowish, greenish, or reddish brown. Mites damage plants by feeding on leaves, which causes stippling, bronzing, and possibly needle drop. Webbing occurs with high populations. The reduction in photosynthesis causes loss of vigor.

Biology and life history Most mite species share a similar life cycle. The majority of twospotted spider mites overwinter as adult females. Spruce spider mites, which are commonly found on conifers, overwinter in the egg stage. Mites become active in the spring. There may be eight to ten overlapping generations per year. Spruce spider mites overwinter as eggs laid at the base of needles or scales. Mites become active in the spring, usually around mid-April. There may be eight to ten overlapping generations per year. Spruce spider mite is a cool season mite with greatest rates of egg laying during the spring and fall.

Scouting and thresholds Observe the leaves for mites and webbing and check for the number of pest and predator mites. Tapping branches over a piece of white paper indicates numbers of mites present. Look for evidence of natural enemy activity.

Management— cultural control

Suppression of broadleaf weeds such as mallow, bindweed, white clover, and knotweed with cultivation or grasses may reduce mite numbers. Wash mites from the tree with a strong stream of water. This also dislodges dust and dirt, which favor an increase in mite numbers. Water trees properly, as drought-stressed trees are more susceptible. Avoid excessive nitrogen applications, as this encourages mites

Management—biological control

See also:

Biological Control of Nursery Pests

Management—chemical control

See also:

Chemical Control of Nursery Pests

Using an ovicide-larvacide in early spring can give good suppression of this mite.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p.472-477).

PNW Nursery IPM: Spruce Spider Mite (http://oregonstate.edu/dept/nurspest/spruce_spider_mite.htm)

PNW Nursery IPM: Biological Control of Twospotted Mite (http://oregonstate.edu/dept/nurspest/two-spottedmite.htm)

Nursery crop pests—Weevil

Pest Description and Damage Black vine weevil is not always the most common weevil to infest landscape plants. In several landscapes in Oregon, the strawberry root weevil and obscure root weevil were dominant, and in Washington often the clay-colored weevil and species of the native woods weevils are the dominant species in many landscapes. Other species are also present in PNW states (*see* below). In Washington there are 16 species that have been found on a variety of plants in landscapes. In Oregon, there are several additional species, including *Plinthodes tineatus* and *Otiorhynchus décoratus*.

It is important to identify the species of root weevil infesting plants (see descriptions below) because of variations in life cycle and susceptibility to pesticides. In the early 1970s, this handbook recommended aldrin, dieldrin, heptachlor and chlordane for the introduced weevils, and malathion and diazinon for native woods weevils.

Adult weevils are small dark beetles with a snout (rostrum) and elbowed antennae. They cannot fly so distribution is through migration or movement of infested pots, soil or debris. Also, the adults of most of the species are all females and capable of laying eggs after a period of feeding to mature their ovaries. They are slow moving and should not be confused with swifter predacious ground beetles. Larvae, found around roots, are C-shaped, legless, and white with tan heads, up to 0.5 inch in size. All species are quite similar in appearance and habits of feeding on root hairs, larger roots and root crown. Adult weevils are night feeders that mostly remain in the soil or in debris at the base of the plant during the day, then climb up to feed on leaves at night. Look for ragged notches on the edges of leaves, or flower petals.

- **Black Vine Weevil** *(Otiorhynchus sulcatus)*—One of our largest root weevils (8–11 mm), this species is black with yellow patches of hairs and smooth rounded tubercles on the thorax. Weevils overwinter as larvae in the soil and adults emerge in early June. A few adults are active in winter months in milder climates. In June, larvae pupate, and adults emerge. Eggs are laid singly or in small clusters in or on the soil from June to September.
- **Strawberry root weevil** *(Otiorhynchs ovatus)*—This 4–6 mm, reddish-black to black, shiny weevil has reddish legs; it appears smooth but on magnification has small hairs and pits. Adults emerge in mid June but some overwinter in warmer climates.
- ***Barypeithes pellucidus***—One of the smallest weevils (2–4 mm), this weevil looks like a tiny strawberry root weevil but is thinner in the side profile and has a soft “down” hairs; one of the few root weevils with males and females (often *in copula*).

Lilac or privet weevil *(Otiorhynchus merdionalis)*—This weevil is the most common species in eastern Washington and known from collections in E. Oregon. It is 8-9 mm with both males and larger females (often found *in copula*). They appear uniformly blackish and shiny.

Rough strawberry root weevil *(Otiorhynchus rugosstriatus)*—This species is 6–8.5 mm, and a uniformly a dark mahogany color (reddish brown) with a "matte finish" It is distinguishable by the squared shape of the elytra when viewed from above and short stiff hairs (just barely visible in the outline of the elytra).

Clay colored weevil *(Otiorhynchus sngularis)* —This species is one of the most numerous in W. Washington landscapes. It is 6–9 mm, mottled brown (tan and brown scales) with scales on legs; there are no hairs on elytra or thorax, the underside is shiny dark brown. It is the earliest to emerge in spring, often in April.

Otiorhyncu raucus—This recent arrival in Oregon and Washington looks slightly shorter and broader than clay colored weevil, overall light brown with a darker thorax. The thorax has fine setae; underside dull brown rather than shiny beneath. Emerges in early spring.

Dark-eyed weevil *(Sciaphilus speratus)*—Another relative newcomer to landscapes, this slightly iridescent golden weevil has a distinctive dark eyes and dark stripe across the elytra.

Nut leaf weevil *(Strophosoma melaogrammum)*—This 4.5–6 mm weevil is a relative newcomer to landscapes. It is slightly iridescent with coppery-brown scales and a distinctive partial dorsal stripe between the elytra. It is a voracious feeder with a somewhat distinctive feeding pattern, often a "maze" of channels from the leaf edge. It is most commonly found in the fall and spring.

Obscure root weevil *(Sciopithes obscurus)*—This native species is diurnal and is more abundant in wooded areas, and in Oregon. It is 3–6.6 mm, is grayish with brown markings with a distinctive V-shaped line at the declivity (rump).

Grass weevil, crusted grass weevil *(Trachyphloeus bifoveolatus)*—This tiny 3–4 mm gray-brown weevil occurs but not commonly in landscapes. It enters houses in large numbers in fall in pastoral areas.

Woods weevil *(Nemocestes incomptus)*—This 6–9 mm native species is sooty dark brown to blackish color with a light band on the side of the thorax and elytra; it covered with short hairs on thorax and elytra. Adults emerge in late summer with numbers peaking in fall. They can feed throughout the winter months in warmer areas.

Horn's woods weevil *(Nemocestes horni)*—This native species is easily mistaken for woods weevil but is slightly smaller (5–8 mm) with some lighter streaks.

Small woods weevil ***(****Nemocestes montanus)*—A smaller (4–5 mm) version of the woods weevil still has the light stripe on the thorax and elytra. Common and occasionally abundant.

Woodburn weevil *(Dyslobus (syn. Lepesoma) granicollis)*—This large native weevil 7–9 mm is found in low numbers especially near wooded areas.

Biology and life history Adults of most species are abundant from through May through September (black vine weevil, strawberry root weevil, rough strawberry root weevil, clay-colored weevil, lilac weevil, woodburn weevil, *Barypiethes pullucidus*, obscure root weevil). Weevils overwinter as larvae in the soil. Feeding may occur throughout mild winters. In April to June, larvae pupate, and adult emergence occurs. Adults are night feeders that remain in the soil or in debris at the base of the plant during the day, then climb up to feed on leaves. Adult weevils cannot fly, but walk or are carried from one location to another. Also, all adults are females capable of laying eggs. Adults are slow moving and should not be confused with swifter predacious ground beetles. Eggs are laid in clusters in or on the soil from June to September. The eggs hatch, and the larvae immediately wriggle through the soil to begin feeding. There is one generation per year.

The woods weevils, nut leaf weevil, grass weevil and *Sciaphilus asperatus* emerge in late summer and are active through the winter and very early in spring. Larvae of the fall emerging species are likely to be present during the summer months.

Scouting and thresholds Observe leaves for first signs of notching in early summer (primroses are an inexpensive preferred host and can be used as an indicator plant for conifer field production. Confirm presence of adults by night inspection of foliage on warm, still evenings. Or, look for adults by day in debris at the base of the plant. Laying a small piece of cardboard at the base of the plant provides a refuge that you can check easily in the early morning. Commercial root weevil traps are available. Inspect the pots of plants by tapping the plant out of the pot, and check for areas of missing roots on the sides and bottom of the pot or for small white, C-shaped grubs. Remove these before planting. If there is evidence weevil have been feeding on root hairs, moved into the rootball it is wise to shake off all soil into a bucket before planting to remove larvae feeding inside the root ball, on larger roots or the root crown. Clean up crossing, kinked roots at the same time.

Management—biological control

See also:

Biological Control of Nursery Pests

Management—chemical control

See also:

Chemical Control of Nursery Pests

Begin adult control when adults emerge in late May and June. Control larvae in the fall. Overwintering adult weevils can lay eggs without the pre-ovipositional feeding interval. Research in strawberries has shown around 25% of black vine weevil adults overwintered successfully. In mild years, growers may need to target these weevils earlier, in April and May, in order to achieve satisfactory weevil management.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 240-243).

Biocontrol of Root Weevils (http://oregonstate.edu/dept/nurspest/Biocontrol_%20root%20weevils.html)

Western Washington Field Guide to Common Small Fruit Root Weevils (http://cru.cahe.wsu.edu/CEPublications/eb1990/eb1990.pdf)

Proceedings of the North American Root Weevil Workshop. SR 1065 (http://hdl.handle.net/1957/8262)

Chemical Control of Nursery Pests

Melissa Scherr and Lloyd Nackley

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Bee warning Read carefully before applying any material selected for use. Many insecticides are highly toxic to honeybees. Some should not be applied any time during bloom, while many others should be applied only in the early morning hours and/or late in the evening. Avoid spraying carbaryl and diazinon on plant surrounded by blooming flowers or weeds. Always take simple steps, such as removing (mowing) blooming clover from lawns adjacent to garden areas before applying materials that are hazardous to bees. In all cases, when given the choice, select the least hazardous material when plants in the infested vicinity are in bloom. Avoid using dusts wherever possible; spray formulations are preferred for bee safety.

Protect pollinators: See How to Reduce Bee Poisoning from Pesticides.

Note: Products are listed by alphabetical order and not in order of preference or superiority of pest control.

For greenhouse plant see:

Greenhouse Ornamental Pests

Characteristics of Insecticides

Using pyrethroid insecticides is associated with subsequent spider mite outbreaks: monitor plant closely after you use these materials.

Pesticides available for use in commercial nursery applications

Active ingredient	Trade name (examples)	Chemical class	Typical use pattern
abamectin	Avid, Lucid	acyclic lactone	translaminar systemic
acephate	Acephate, Orthene	organophosphate	foliar systemic
acequinocyl	Shuttle	nathoquinone	spider mite
acetamiprid	Tristar	chloro-nicotinyl	whitefly, aphid, adelgid, scale, psyllid, mealybug, leafhopper, thrips, leafminer, plant bug, leaf-eating beetles, fungus gnat larvae, borers
afidopyropen	Ventigra	pyridine azomethines	aphid, mealybug, whitefly, scale
alpha-cypermethrin	Fendona	sodium channel modulator	liquid application/ground application
ammonium nonanoate	Axxe Broad Specturm	dessicant	liquid ground application
azadirachtin	Amazin (organic) Azatin, Aza-Direct (OMRI), Azatrol (OMRI) Ornazin	terpenoid: insect growth regulator	immature stages of insects antifeedant, biopesticide.
Bacillus thuringiensis	various (organic labels available)	microbial	specific, depends on variety; biopesticide

Pesticides available for use in commercial nursery applications

Active ingredient	Trade name (examples)	Chemical class	Typical use pattern
Beauveria bassiana	Botanigard, Mycotrol, Velifer	fungus	whitefly, aphid, pysllid, thrips, weevil, mealybug, beetles
bifenazate	Floramite	carbazate	spider mite—good coverage is especially important; compatible with predacious mite.
bifenthrin	Talstar, Wisdom, many labels	pyrethroid	general, check the label; most are restricted use pesticides.
buprofezin	Talus	insect growth regulator	scale, whitefly, mealybug, leafhopper, pear psylla acts on immature stages.
Burkholderia spp.	Venerate XC (OMRI)	bioinsecticide	loopers, aphids, mites, thrips, whiteflies, armyworms, twig borers, leafrollers, webworm, mealybugs, scale
canola oil	Mighty, Captiva, Pycana	botanical oil	flea beetles, fungus gnat, whitefly, caterpillars, scale, thrips, lygus, psylla, aphid, spider mites
carbaryl	Carbaryl 4L - Sevin	carbamate	general, check label for pest list.
carbon dioxide	IGI Carbon Dioxide	gas	fumigant, treats many beetles
chlorantraniliprole	Acelepryn	anthranilic diamide	caterpillar, Japanese beetle, white grub
chlorfenapyr	Pylon	pyrroles	spider mites, thrips, fungus gnats, caterpillars
chloropicrin	Pic 100	liquid and fumigant	greenhouse pests, wireworm
chlorpyrifos	Vulcan, Whirlwind	acetylcholinesterase inhibitor	aerial, ground and irrigation applications
Chromobacterium	Grandevo	microbial	general, check the label for pest lift.
cinnamaldehyde	Seican		borer, plant bug, mite, lepidoptera, scale, lygus, mealybug, thrips, fungus gnat,
cinnamon oil	Gargoil, Canelys	horticultural oil	fungicide and insecticide; applied as a liquid
citric acid, clove oil, corn oil	PureAg	horticultural oil	ground application as liquid
citronella/farneson/geraniol/ner	Biomite	botanical	mite

Pesticides available for use in commercial nursery applications

Active ingredient	Trade name (examples)	Chemical class	Typical use pattern
olidol			
clofentezine	Ovation	tetrazine	spider mite
clothianidin	Arena	neonicotinoid	aphid, mealybug, whitefly, adelgid, lacebug, leaf beetle, psyllid, root weevils, systemic
corn oil	Circadian Sunrise		rust mite, whitefly, leafhopper, spider mite, aphid, mealybug
cottonseed oil	Furious	mineral oil	spray control, broad spectrum
cryolite	Cryolite Bait	inorganic	weevils
cyantraniliprole	Mainspring	raynoid	plant bug, lepidoptera, soft scale, thrips, whitefly, Japanese beetle
cyclaniliprole	Sarisa	diamide	adelgid, aphid, borer, lace bug, leafminer, mealybug, midge, psyllids, root weevil, sawfly, soft scale, thrips, Japanese beetle
cyclaniliprole/flonicamid	Pradia	diamide	adelgid, aphid, borer, lace bug, leafminer, mealybug, midge, psyllids, root weevil, sawfly, soft scale, thrips, stinkbug
cyflumetofen	Sultan Miticide	nitrile	mites
cyfluthrin	Decathlon	pyrethroid	general – check the label; restricted use pesticide.
cyfluthrin/imidacloprid	Discus	pyrethroid/neonicotinoid	general – check the label; combination product; systemic; restricted use pesticide.
cyhalothrin-gamma	Declare	pyrethroid	deciduous shade tree ornamental general use, check the label
cypermethrin	Enforcer	pyrethroid	ant, silverfish, sowbug, earwig, spider, tick greenhouse, seed house, and commercial building treatments; restricted use pesticide.
cyromazine	Citation	triazine: insect growth regulator	acts on immature fungus gnat, leaf miner, shore fly.
diazinon	Diazinon	organophosphate	general; restricted use pesticide.

Pesticides available for use in commercial nursery applications

Active ingredient	Trade name (examples)	Chemical class	Typical use pattern
diflubenzuron	Dimilin 4L, Adept, Diflumax	benzyl phenyl urea: insect growth regulator	acts on immature stages, conifer nursery lepidopteran pests; restricted use pesticide.
dimethoate	Dimethoate	organophosphate	general – check the label; systemic.
dinotefuran	Safari	neonicotinoid	aphid, adelgid, mealybug, whitefly, fungus gnat, weevil, psyllid, bagworm, borer, Japanese beetle, thrips, scale; systemic.
emamectin benzoate	Tree-age, Mectinite	benzoate	aphid, leafminer, sawfly, borer, mites, lepidoptera; conifer and forest nursery, ornamentals and seed orchards
esfenvalerate	Fenvastar EcoCap, Asana, Ztrate	pyrethroid	spiders, scorpions, check the label for other pests.
ethoprop	Mocap	organophosphate	nematode, symphylan, field nurseries only, pre-plant only: easter lilies (Curry County, OR); SLN OR-120005.
etoxazole	TetraSan	oxazolin; insect growth regulator	spider mite
fenazaquin	Magus Miticide	quinazoline	spider mite, whitefly
fenbutatin oxide	Vendex, Meraz	organotin	spider mite
fenpropathrin	Tame 2.4 EC	pyrethroid	general – check the label; restricted-use pesticide
fenpyroximate	Akari	phenoxypyrazole	spider mite, broad mite, cyclamen mite, eriophyid mite, mealybug
flonicamid	Aria Insecticide	pyridinecarboxamide	aphid, thrips, whitefly, scale leafhopper, mealybug, plant bug
flupyradifurone	Altus	butenolides	leafminer, leafhopper, mealybug, lace bug, scale, whitefly, aphid, psylla
geraniol	Keyplex Ecotrol Plus	botanical	mite, thrips, leaf miner, aphid, mealybug, leafminer, armyworm, flea beetle, fungus gnat, scale
GS-omega/kappa-HXTX-HV1A	Spear-Lep	fatty acid	tomato hornworm, omnivorous leafroller, armyworm, looper

Pesticides available for use in commercial nursery applications

Active ingredient	Trade name (examples)	Chemical class	Typical use pattern
hexythiazox	Hexagon	organosulfur	spider mite, ovicidal, larvicidal
hydramethylnon	Amdro, MaxForce	trifluoromethyl aminohydrazone	ant, cockroach, earwig, silverfish
imidacloprid	Imidacloprid, Marathon	chloronicotinyl	general – check the label; systemic
indoxacarb	Advion Fire Ant Bait	carbamate	fire ant
iron phosphate	Bug-N-Sluggo		slug, snail
Isaria fumosorosea strain 97	Preferal Microbial Insecticide, Ancora	microbial	general – check the label
kaolin	Novasource	barrier	spray application, aerial or ground
lambda-cyhalothrin	Cyonara , Scimitar GC	pyrethroid	general – check the label; restricted use pesticide
lime-sulfur	Rex Lime	liquid	ground application, unknown MOA
malathion	Malathion 5EC, Fyfanon,	organophosphate	check the label for non-tolerant plants
metaflumizone	Siesta Insecticide Fire Ant Bait	semicarbazones	fire ant
metam-sodium	Metam CLR	fumigant and liquid	fungicide/insecticide
Metarhizium anisopliae strain 52	Met 52, Tick-Ex EC	biological, fungus	root weevil grubs, mite, whitefly, thrips
methiocarb	Mesurol	carbamate	slug, snail, aphid, thrips; restricted use
methoxyfenozide	Intrepid 2F	diacylhydrazine	caterpillar
methyl bromide	MBC Concentrate, Terr-O Gas	fumigant	ecdysone receptor antagonist
mineral oil, petroleum distillate	Various	oil	soft-bodied pests
neem oil, clarified hydrophobic extract	Triact (OMRI), Ecoworks EC	botanical oil	fungicide, miticide, insecticide, whitefly, mealybug, aphid, leafhopper
novaluron	Pedestal	benzoylphenyl urea	whitefly, thrips, leafminer, armyworm; insect growth regulator
permethrin	Permethrin, Loveland, Arctic many labels	pyrethroid	general – check the label; most are restricted-use pesticides
phosmet	Imidan	organophosphate	birch leafminer, slug, gypsy moth,

Pesticides available for use in commercial nursery applications

Active ingredient	Trade name (examples)	Chemical class	Typical use pattern
			Japanese beetle, tent caterpillar, mealybug
phosphorus acid	Mite-Phite		spider mite
piperonyl butoxide	Evergreen, Pyronyl	sodium channel modulator	multiple applications available; general insecticidal use
polyhedral occlusion bodies	Helicovex		tomato fruitworm, budworm, corn earworm
potassium laurate	M-Pede, Insecticidal Soap (several OMRI, organic)	soap	general, contact only, no residual.
potassium silicate	SIL-Matrix		aphid, mite, whitefly
propargite	Omite	organosulfur	mite
propyleneglycol monolaurate	Acaritouch	fatty acid monoester	spider mite – good contact required.
pymetrozine	Endeavor	triazine	aphid, whitefly
pyrethrins/piperonyl butoxide (PBO)	PT 1600 X-clude, PT Pyrethrum TR	pyrethrins/synergist	general – check the label.
pyrethrins/canola	PyGanic Dust (OMRI), Mighty	pyrethrins	general – check the label.
pyridaben	Sanmite	pyridazinone	spider mite, whitefly
pyridalyl	Overture	unclassified	lepidoptera, thrips
pyriproproxyfen	Defiance	juvenile hormone mimic	labeled for use in nursery greenhouses only
sodium borate complex	Prev-Am Ultra	inorganic	aphid, leafhopper, lygus, mealybug, mite, thrips, whitefly, scale
soybean oil	Golden Pest Spray Oil		spider mite, fungus gnat, lace bug, whitefly, leafminer, scale, aphid, mealybug
spinetoram, sulfoxaflor	Xxpire	spinosyns	bagworm, looper, spider mite, tussock moth, lacebug
spinosad	Conserve, Entrust	fungal metabolite	thrips, caterpillar, midge
spiromesifen	Savate Miticide	ketoenole	spider mite, broad mite, cyclamen mite, false spider mite, eriophyid mite, whitefly

Pesticides available for use in commercial nursery applications

Active ingredient	Trade name (examples)	Chemical class	Typical use pattern
spirotetramat	Kontos	tetramic acid	aphid, adelgid, whitefly, rust mite, spider mite, psyllid, spittlebug, mealybug, leafhopper, thrips; systemic chemistry
sulfoxaflor	Transform	nicotinic acetetylcholine receptor modulator	available as a spray powder for various applications
tau-fluvalinate	Mavrik Aquaflow	pyrethroid	general, container stock only
tebufenozide	Mimic	hydrazine, IGR	acts on moth immature stages.
thiamethoxam	Flagship	neonicotinoid	beetle grub, aphid, whitefly, mealybug
zeta-cypermethrin	Amdro Quick Kill	sodium channel modulator	liquid/ground application

Pesticides registered for use on specific nursery pests

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adelgid

acephate (Ace-Jet)
acetamiprid (TriStar 8.5 SL)
ammonium nonanoate (Axxe Broadspectrum)
azadirachtin (Azatin O)
bifenthrin (Talstar P, various)
canola oil (Earth-tone Hort Oil)
chlorpyrifos (Vulcan)
cottonseed oil (Furious)
cyantraniliprole (Mainspring)
cyclaniliprole (Sarisa)
cyclaniliprole/flonicamid (Pradia)
cyfluthrin/imidacloprid (Discus)
cyhalothrin (Discus)
dinotefuran (Safari)
esfenvalerate (Asana XL)
imidacloprid (Marathon, various)
lambda-cyhalothrin (Willowood Lambda)
mineral oil/petroleum distillate (various)
potassium laurate (various)
pyrethrins (various)
soybean oil (Golden Pest)
spirotetramat (Kontos)—Systemic activity
tau-fluvalinate (Mavrik Aquaflow)
thiamethoxam (Flagship 25WG)

aphid

abamectin (Avid)
acephate (Orthene TR, Acephate 90 WGT, various)
acetamiprid (TriStar 8.5 SL)—Systemic activity
ammonium nonanoate (Axxe Broadspectrum)
azadirachtin (Azatin O O, Neemix 4.5, various)—Acts as an insect growth regulator and anti-feedant.
Beauveria bassiana (Botanigard, Naturalis L)—Fungal pathogens.
bifenthrin (Talstar P, various)
Burkholderia spp. (Venerate XC)
canola oil (Earth-tone Hort Oil)—Other oils include clove, cottonseed, rosemary, peppermint, sesame.
carbaryl (Sevin)
chlorpyrifos (chlorpyrifos 4E)
Chromobacterium subtsugae (Grandevo)
cinnamaldehyde (Cinnacure)
cinnamon oil (Gargoil)
citric acid (PureAg Pest Control)
clothianidin (Arena)
corn oil (Circadian Sunrise)
cottonseed oil (Furious)
cyantraniliprole (Mainspring)
cyclaniliprole (Sarisa) WA only

cyclaniliprole/flonicamid (Pradia)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
diazinon (Diazinon)
dimethoate (Dimate, Dimethoate)
dinotefuran (Safari)
emamectin (Mectinite)
esfenvalerate (Fenvastar EcoCap)
fenpropathrin (Tame)
fenpropathrin/acephate (Tame/Orthene TR)
flonicamid (Aria)
flupyradifurone (Altus)
geraniol (Keyplex Ecotrol)
gs-omega/kappa-HXTX-HV1A (Spear T Liquid Concentrate)
horticultural oil (various)
imidacloprid (Marathon, various)
Isaria fumosorosea Apopka strain 97 (Preferal Microbial Insecticide, PFR 97)
kaolin (Surround)—May leave residue; thorough coverage essential.
lambda-cyhalothrin (Scimitar, various)
lime sulfur (Rex)
malathion (various)
methiocarb (Mesurol)
mineral oil
neem oil (Trilogy)
permethrin (Ambush, Pounce, Permethrin, various)
phosmet (Imidan 70-W)
piperonyl butoxide (Evergreen)
potassium laurate (various)
potassium silicate (Sil-Matrix)
pymetrozine (Endeavor)
pyrethrin (PyGanic Dust)
pyrethrin/canola (various)
pyrethrin/PBO3
pyridaben (Sanmite)
pyriproxyfen (Distance)—Apply to the immature stages of the insect.
sodium borate (Prevam)
soybean oil (Golden Pest)
spinetoram (XXPire)
spirotetramat (Kontos)—Systemic activity
sulfoxaflor (Transform WG)
tau-fluvalinate (Mavrik Aquaflow)
thiamethoxam (Flagship 25WG)

borers (general)

(E,Z)-3, 13-octadecadienyl acetate (Isomate-P)
acephate (Acephate 90WDG)
acetamiprid (Quasar)
azadiractin (Azatin O, Neemix 4.5, various)
Bacillus thuringiensis (Xentari, Dipel and others)
Beauveria bassania (Mycotrol, BoteGHA)
bifenthrin (Talstar P, various)
Burkholderia spp. (Venerate)
canola oil (Captiva)
carbaryl (Sevin)
carbon dioxide (IGI Carbon Dioxide)
chlorpyrifos (Vulcan)
Chromobacterium (Grandevo)
cinnamaldehyde (Cinnacure)
cinnamon oil (Gargoil)
cyantraniliprole (Mainspring)

cyclaniliprole (Sarisa) WA only
cyclaniliprole/flonicamid (Pradia)
cyfluthrin/imidacloprid (Discus)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
diazinon (ADAMA)
dimethoate (Dimate, Dimethoate)
dinotefuran (Safari)
emamectin benzoate (TREE-age)
esfenvalerate (Fenvastar EcoCap)
ethoprop (Mocap)
gs-omega/kappa-HXTX-HV1A (SPEAR-Lep)
imidacloprid (Marathon, various)
lambda-cyhalothrin (Scimitar, various)'
lime sulfur (Rex Lime)
malathion
methoxyfenozide (Intrepid)
mineral oils, various
neem oil (Rango, Debug)
novaluron (Rimon)
permethrin (Ambush, Pounce, Permethrin, various)
phosmet (Imidan)
piperonly butoxide (Evergreen)
pyrethrins
spinosad (Conserve, Entrust)

caterpillars

abamectin (Abacide 2Hp)
acephate (Orthene, various)
acetamiprid (TriStar 8.5 SL)
alpha-cypermethrin (Fendona)
ammonium nonanoate (Axxe Broad Spectrum)
azadirachtin (Azatin O, Neemix 4.5, various)
Bacillus thuringiensis aizawai (Xentari DF, various)—Most effective on younger stages of the caterpillars.
Bacillus thuringiensis kurstaki (BioBit, Dipel)—Most effective on younger stages of the caterpillars.
bifenthrin (Talstar P, various)
Burkholderia spp. (Venerate XC)
canola oil (Captiva, Mighty)
carbaryl (Sevin)
chitosan (EcoHalt)
chlorfenapyr (Pilon, Piston)
chlorpyrifos (Nufarm)
Chromobacterium subtsugae (Grandevo)
cinnamaldehyde (Cinnacure)
cinnamon oil (Gargoil)
clothianidin (Arena)
cyantraniliprole (Mainspring)
cyclaniliprole (Sarisa)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
diazinon (Adama)
diflubenzuron (Dimilin, Diflumax)
dinotefuran (Safari)
emamectin (TREE-age, Mectinite)
esfenvalerate (Fenvastar EcoCap)
geraniol (Keyplex Ecotrol Plus)
gs-omega/kappa-HXTX-HV1A (SPEAR-Lep)
Isaria fumosorosea Apopka strain 97 (Preferal Microbial Insecticide, PFR 97)
kaolin (Novasource)
lambda-cyhalothrin (Scimitar, various)

malathion (Ambush, Permethrin, various)
methoxyfenozide (Intrepid)—Begin applications when larvae are observed or at the first sign of feeding damage.
mineral oil/petroleum distillate (various)—Apply in delayed–dormant period to destroy overwintering egg masses.
neem oil (Ecoworks, Terraneem)
novaluron (Pedestal)
permethrin (Ambush, Pounce, various)
phosmet (Imidan 70-W)
piperonyl butoxide (Evergreen)
potassium laurate (various)
pyrethrin (Pyganic Dust)
pyrethrin/piperonly butoxide
pyridalyl (Overture)
soybean oil (Golden Pest)
spinetoram (XXPire)
spinosad (Conserve, Entrust SC OMRI approved)
tau-fluvalinate (Mavrik Aquaflow)
tebufenozide (Minic)—Apply at initiation of egg hatch.

clearwing borer

acephate (Acephate 90 WDG)
bifenthrin (Talstar P, various)
chlorpyrifos (Vulcan, Drexel)
cyantraniliprole (Mainspring)
pyrethrin (Pyganic Dust)

cone worm

acephate (Acephate 90WDG)
azadirachtin (Safer Brand Bioneem)
*Bacillus thuringiensis azawai (*Xentari DF)
Bacillus thuringiensis kurstaki (BioBit, Dipel, various)
carbaryl (Sevin)
cyhalothrin (Declare)
emamectin (TREE-age)
esfenvalerate (ASANA XL and others)
lambda-cyhalothrin (Adama, LAMCAP II)
permethrin (Ambush, Pounce, Permethrin, various)
phosmet (Imidan)
pyrethrins (Evergreen)
spinosad (Conserve, Entrust)

flea beetle

acephate (Orthene, various)
acetamiprid (Quasar)
azadirachtin (Azatin O, Neemix 4.5, various)—Acts as an insect growth regulator and anti-feedant.
Beauveria bassiana (Botanigard, Naturalis L)
bifenthrin (Talstar P, various)
canola oil (Mighty, Pycana)
carbaryl (Sevin)
chlorpyrifos (Whirlwind)
cyclaniliprole (Sarisa)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
diazinon (Diazinon)
esfenvalerate (Fenvastar EcoCap)
ethoprop (Mocap)
geraniol (KeyPlex Ecotrol Plus)
imidacloprid (Marathon, various)
kaolin (Surround)
lambda-cyhalothrin (Scimitar, various)
malathion (various)

neem oil (Nimbiosys, Ecoworks)
permethrin (Ambush, Pounce, Permethrin, various)
phosmet (Imidan)
piperonyl butoxide (Evergreen)
pyrethrin (Pyganic Dust)
pyrethrin/piperonyl butoxide
spinosad (Conserve, Entrust)
tau-fluvalinate (Mavrik Aquaflow)
thiamethoxam (Flagship 25WG)

lace bug

acephate (Orthene, various)
ammonium nonanoate (Axxe Broad Spectrum)
azadiractin (Azatin O, Neemix 4.5, various)
Beauveria bassiana (Botanigard, Naturalis L)
bifenthrin (Talstar P, various)
Burholderia spp. (Venerate, Zelto)
canola oil (Mighty, Pycana)
carbaryl (Sevin)
chlorpyrifos (Dursban)
*Chromobacterium subtsugae (*Grandevo)
clothianidin (Arena)
cyantraniliprole (MainSpring)
cyclaniliprole (Sarisa) WA only
cyclaniliprole/flonicamid (Pradia)
cyfluthrin (Decathlon 20WP)
dimethoate (Dimate, Dimethoate)
dinotefuran (Safari)
fenpropathrin/acephate (Tame/Orthene TR)
flupyradifurone (Altus)
imidacloprid (Marathon, various)
lambda-cyhalothrin (Scimitar, various)
malathion (various)
mineral oil/petroleum distillate (various)
permethrin (Ambush, Pounce, Permethrin, various)
piperonyl butoxide (Evergreen)
potassium laurate (various)
pyrethrins (Pyganic Dust)
soybean oil (Golden Pest)
spinetoram (XXPire)
sulfoxaflor (Transform WG)
thiamethoxam (Flagship 25WG)

leaf beetle

acephate (Orthene, various)
acetamiprid (TriStar 8.5 SL)
azadirachtin (Azatin O, Neemix 4.5, various)
Beauveria bassiana (Botanigard, Naturalis L)
bifenthrin (Talstar P, various)
canola oil (Pycana)
carbaryl (Drexel, Carbaryl 4L)
chlorpyrifos (Vulcan, Warhawk)
Chromobacterium subtsugae (Grandevo)
cyantraniliprole (MainSpring)
cyclaniliprole (Sarisa)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
dimethoate (Dimate, Dimethoate)
dinotefuran (Safari)

esfenvalerate (Fenvastar EcoCap)
geraniol (KeyPlex, Essentria)
imidacloprid (Marathon, various)
kaolin (NovaSource)
lambda-cyhalothrin (Scimitar, various)
malathion (Drexel, Fyfanon)
mineral oil/petroleum distillate (various)
neem oil (EcoWorks)
permethrin (Ambush, Pounce, Permethrin, various)
phosmet (Imidan)
piperonyl butoxide (Evergreen)
potassium laurate (various)
pyrethrins (Lynx, Tersus, others)
sodium borate (Prev-Am)
soybean oil (Golden Pest)
spinetoram (XXPire)
spinosad (Entrust)
tau-fluvalinate (Mavrik)
thiamethoxam (Flagship 25WG)

leafhopper

abamectin (Willowood)
acephate (Orthene, various)
acetamiprid (TriStar 8.5 SL)
azadirachtin (Azatin O, Neemix 4.5, various)
Beauveria bassiana (Botanigard, Naturalis L)
bifenthrin (Talstar P, various)
buprofezin (Talus 70DF IGR)—Do not rotate with chitin synthesis inhibitors.
Burkholderia spp. (Venerate, Zelto)
canola oil (Earth-tone Hort Oil)
canola oil/pyrethrin (various)
carbaryl (Sevin)
chlorpyrifos (DUrsban, Quali-Pro)
Chromobacterium (Grandevo)
cinnamaldehyde (Cinnacure)
cinnamon oil (Gargoil)
clothianidin (Arena)
corn oil (Circadian Sunrise)
cottonseed oil (Furious)
cyclaniliprole (Sarisa, Pradia)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare).
diazinon (Diazinon)
dimethoate (Dimate, Dimethoate)
dinotefuran (Safari)
esfenvalerate (Fenvastar EcoCap)
fenazaquin
fenpropathrin (Tame 2.4EC)
flonicamid (Aria)
flupyradifurone (Altus)
geraniol (Keyplex)
imidacloprid (Marathon, various)
Isaria fumosorosea (No-Fly)
kaolin (Novasource)
lambda-cyhalothrin (Scimitar, various)
malathion (various)
mineral oil/petroleum distillate (various)
neem oil, (Triact, Trilogy)—Pre-test on small number of plants to check for phytotoxicity. Buffer spray solution to pH 5.5-7.0.
novaluron (Rimon)
permethrin (Ambush, Pounce, Permethrin, various)

phosmet (Imidan)
piperonyl butoxide (Evergreen)
potassium laurate (various)
pyrethrins (Pyganic Dust)
pyridaben (Sanmite Miticide)
sodium borate (Prev-AM)
soybean oil (Golden Pest)
spirotetramat (Kontos)—Systemic activity.
tau-fluvalinate (Mavrik Aquaflow)
thiamethoxam (Flagship 25WG)

leafroller

abamectin (Willowood)
acephate (Orthene, various)
acetamiprid (Quasar)
azadiractin (Azatin O, Neemix 4.5, various)
Bacillus thuringiensis aizawai (Xentari DF)—Works best on small larvae.
Bacillus thuringiensis kurstaki (Dipel, Dipel various)
Beauveria bassiana (Botanigard,Naturalis L)
bifenthrin (Talstar P, various)
Burkholderia spp. (Venerate)
canola oil (Earth-tone Hort Oil)
carbaryl (Sevin)
chlorpyrifos (Govern, Lorsban)
Chromobacterium subtsugae (Grandevo)
cinnamaldehyde (Cinnacure)
cinnamon oil (Gargoil)
clothianidin (Arena)
cyantraniliprole (MainSpring)
cyclaniliprole (Sarisa, Pradia)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
diazinon (Diazinon)
esfenvalerate (Fenvastar EcoCap)
fenpropathrin (Tame 2.4EC)
geraniol (Keyplex Ecotrol Plus)
gs-omega/kappa-HXTX-HV1A (SPEAR-Lep)
kaolin (Surround)
lambda-cyhalothrin (Scimitar, various)
malathion (Fyfanon, many others)
methoxyfenozide (Intrepid)—Specific to caterpillars; mimics action of molting hormone.
mineral oil/petroleum distillate (various)
neem oil (Ecoworks, Rango)
novaluron (Rimon)—Apply to immature insects.
permethrin (Ambush, Pounce, Permethrin, various)
phosmet (Imidan)
piperonyl butoxide (Evergreen)
potassium laurate (M-Pede)
pyrethrin (Pyganic Dust)
pyridaben (Sanmite)
soybean oil (Golden Pest)
spinetoram (XXPire)
spinosad (Conserve, Entrust)

midge

acephate (Tide, Ace-Jet, others)
acetamiprid (TriStar 8.5 SL)
azadirachtin (Azatin O, Neemix 4.5, various)
bifenthrin (Talstar P, various)
Burkholderia spp. (Venerate)

canola oil (Mighty, Pycana)
carbaryl (Drexel Carbaryl 4)
chlorpyrifos (Pilot, Cobalt)
cyclaniliprole (Sarisa) WA only
cyclaniliprole/flonicamid (Pradia)
cyfluthrin (Decathlon 20WP)
cyfluthrin/imidacloprid (Discus)
cyhalothrin (Declare)
dimethoate (Dimate, Dimethoate)
esfenvalerate (Fenvastar EcoCap)
fenpyroximate (Akari)
geraniol (KeyPlex)
imidacloprid (Star Specialty, Imicide, others)
kaolin (Surround)—May leave residue.
lambda-cyhalothrin (Scimitar, various)
mineral oil (several)
neem oil (Nimbiosys, EcoWorks)
piperonyl butoxide (Evergreen)
pyrethrin (Pyganic Dust)
soybean oil (Golden Pest)
spinetoram (XXPire)
spinosad (Conserve, Entrust)
thiamethoxam (Flagship 25WG)

mite, eriophyid

abamectin (Avid)
carbaryl (Sevin)
fenzaquin (Magister)
fenpyroximate (Akari)
mineral oil/petroleum distillate (various)
pyrethrins (several)
spiromesifen (Savate)—Avoid geranium, ferns, English ivy, Alstromeria, Impatiens.

mite, spider

abamectin (Avid)
acephate (Orthene, various)
acequinocyl (Shuttle)
azadirachtin (Azatin O, Neemix 4.5, various)
Beauveria bassiana (Mycotrol, BoteGHA)
bifenazate (Floramite SC)—Good coverage is especially important. Compatible with predatory mites.
bifenthrin (Talstar P, various)
Burkholderia spp. (Venerate XC)
canola oil (Mighty, Pycana)
carbon dioxide (IGI Carbon Dioxide)
chlorfenapyr (Pylon TR)
chlorpyrifos (Vulcan)
Chromobacterium subtsugae (Grandevo)
cinnamaldehyde (Cinnacure)
cinnamon oil (Canelys)
citronellol (BioMite)
clofentezine (Ovation SC)
corn oil (Circadian Sunrise)
cottonseed oil (Furious)
cyflumetofen (Sultan Miticide)
cyhalothrin (Declare)
diazinon (Diazinon)
dimethoate (Dimate, Dimethoate)
etoxazole (TetraSan)
fenazaquin (Magister)
fenbutatin-oxide (Vendex, Meraz)

fenpropathrin/acephate (Tame/Orthene TR)
fenpyroximate (Akari)
geraniol (Biomite)
gs-omega/kappa-HXTX-HV1A (SPEAR T Liquid)
hexythiazox (Hexygon, Onager)
Isaria fumosorosea (Ancora, PFR-97)
lambda-cyhalothrin (Scimitar, various)
lime sulfur (Rex Lime)
malathion (various)
mineral oil/petroleum distillate (various)—Horticultural oils are most effective against the egg stage.
neem oil (Ecoworks, DeBug)
phosphorus acid (Mite-Phite)
piperonyl butoxide (Evergreen)
potassium laurate (various)
propargite (Omite)
propylene glycol monolaurate (Acaritouch)
pyrethrins (Pyganic Dust)
pyrethrins/piperonyl butoxide
pyridaben (Sanmite)
soybean oil (Golden Pest)
spinetoram (Delegate)
spinosad (Conserve, Entrust)
spiromesifen (Judo)
spirotetramat (Kontos)—Systemic activity.
tau-fluvalinate (Mavrik Aquaflow)

needleminer

carbaryl (Sevin)
chlorpyrifos (Vulcan, Whirlwind)

peachtree borer

(E,Z)-3, 13-octadecadienyl acetate (Isomate-P)
azadirachtin (Azatin O, Neemix 4.5, various)
bifenthrin (Talstar P, various)
carbaryl (Sevin)
chlorpyrifos (Whirlwind, Warhawk)
cyantraniliprole (MainSpring)
cyhalothrin (Declare)
dinotefuran (Safari)
esfenvalerate (Fenvastar EcoCap)
lambda-cyhalothrin (Scimitar, various)
malathion (Fyfanon, Malathion)
neem oil (Ecoworks, Rango)
permethrin (Ambush, Pounce, Permethrin, various)
pyrethrins (Evergreen)

peach twig borer

azadirachtin (Azatin O, Neemix 4.5, various)
Bacillus thuringiensis kurstaki (Dipel, various)
bifenthrin (Talstar P, various)
Burkholderia spp. (Venerate)
canola oil (Pycana)
carbaryl (Sevin)
chlorpyrifos (Vulcan)
Chromobacterium subtsugae (Grandevo)
cinnamaldehyde (Cinnacure)
cyhalothrin (Declare)
diazinon (Diazinon)
esfenvalerate (Fenvastar EcoCap)
gs-omega/kappa-HXTX-HV1A (SPEAR-Lep)

lambda-cyhalothrin (Scimitar, various)
lime sulfur (Rex Lime)
malathion (Gowan)
methoxifenozide (Intrepid)—Specific to caterpillars; apply at initiation of egg hatch.
mineral oil/petroleum distillate (various)
neem oil (EcoWorks, Rango)
permethrin (Ambush, Pounce, Permethrin, various)
phosmet (Imidan)
pyrethrins (Evergreen)
spinosad (Conserve, Entrust)

plant bug

acephate (Orthene, various)
acetamiprid (TriStar)
ammonium nonanoate (Axxe Broad Spectrum)
Beauveria bassiana (Botanigard, Naturalis L)
bifenthrin (Talstar P, various)
canola oil/pyrethrin (various)
carbaryl (Sevin)
chlorpyrifos (Vulcan)
*Chromobacterium subtsugae (*Grandevo)
cinnamaldehyde (Seican)
cyantraniliprole (Mainspring)
cyclaniliprole (Pradia)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
dimethoate (Dimate, Dimethoate)
dinotefuran (Safari)
emamectin (Tree-age)
esfenvalerate (Fenvastar EcoCap)
fenpropathrin (Valent)
flonicamid (Aria)
flupyradifurone (Altus)
geraniol (KeyPlex)
imidacloprid (Marathon, various)
Isaria fumosorosea Apopka strain 97 (Preferal Microbial Insecticide, PFR 97)
kaolin (Novasource)
lambda-cyhalothrin (Scimitar, various)
malathion
mineral oil/petroleum distillate (various)
neem oil (Rango)
novaluron (Pedestal)
permethrin (Ambush, Pounce, Permethrin, various)
phosmet (Imidan)
piperonyl butoxide (Evergreen)
potassium laurate (various)
pyrethrins
soybean oil (Golden Pest)
sulfoxaflor (Transform)
tau-fluvalinate (Mavrik Aquaflow)
thiamethoxam (Flagship 25WG)

psyllid

abamectin (Willowood)
acetamiprid (TriStar)
ammonium nonanoate (Axxe Broad Spectrum)
azadirachtin (Azatin O, Neemix 4.5, various)
Beauvaria bassiani (Botanigard, Naturalis O)
bifenthrin (Talstar P, various)
buprofezin (Talus)

Burkholderia spp. (Botanigard)
canola oil (Earth-tone Hort Oil)
carbaryl (Sevin)
chlorpyrifos (Dursban)
*Chromobacterium subtsugae (*Grandevo)
cinnamaldehyde (Seican)
cinnamon oil (Canelys)
cyantraniliprole (MainSpring)
cyclaniliprole (Sarisa) WA only
cyclaniliprole/flonicamid (Pradia)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
dimethoate (Dimate, Dimethoate)
dinotefuran (Safari)
esfenvalerate (Fenvastar EcoCap)
fenazaquin (Magister)
fenpyproximate (Akari)
flupyradifurone (Altus)
geraniol (Keyplex)
hexythiazox (Ruger, Hexamite)
imidacloprid (Marathon, various)
Isaria fumosorosea Apopka strain 97 (Preferal Microbial Insecticide, PFR 97)
kaolin (Surround)
lambda-cyhalothrin (many)
mineral oil/petroleum distillate (various)
neem oil (Ecoworks, Rango)
permethrin (Pounce, Arctic, others)
piperonyl butoxide (Evergreen)
potassium laurate (various)
pyrethrin (Pyganic Dust)
sodium borate (Prev-Am)
soybean oil (Golden Pest Spray)
spirotetramat (Kontos)
sulfoxaflor (Transform)
tau-fluvalinate (Mavrik Aquaflow)
thiamethoxam (Flagship 25WG)

root weevil

acephate (Orthene, various)
Bacillus thuringiensis (beetleGONE!)
Beauveria bassiana (Botanigard, Naturalis L)
bifenthrin (Talstar P, various)
clothianidin (Arena)
cottonseed oil (Furious)
cryolite (Gowan Cryolite Bait)
cyclaniliprole/flonicamid (Pradia)
cyfluthrin/imidacloprid (Discus L)
diazinon (Adama, Diazinon)
dinotefuan (Safari)
esfenvalerate (Asana, Zyrate)
imidacloprid (Marathon, various)
Isaria fumosorosea Apopka strain 97 (Preferal Microbial Insecticide, PFR 97)
lambda-cyhalothrin (Scimitar, various)
malathion (Drexel, Fyfanon)
permethrin (Ambush, Pounce, Permethrin, various)
phosmet (Imidan)
pyrethrins (Pyganic Dust)
tau-fluvalinate (Mavrik Aquaflow)
thiamethoxam (Flagship 25WG)

sawfly

acephate (Orthene, various)
acetamiprid (Tristar, Quasar)
ammonium nonanoate (Axxe Broad Spectrum)
azadirachtin (Azatin O, Neemix 4.5, various)
bifenthrin (Talstar P, various)
canola oil (Earth-tone Hort Oil)
canola oil/pyrethrin (various)
carbaryl (Sevin)
chlorpyrifos (Cobalt, Vulcan)
cottonseed oil (Furious)
cyclaniliprole (Sarisa) WA only
cyclaniliprole/flonicamid (Pradia)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
diazinon (Diazinon, Adama)
diflubenzuron (Dimilin 25W)
dimethoate
dinotefuran (Safari)
emamectin (TREE-age, Mectinite)
esfenvalerate (Fenvastar EcoCap)
geraniol (Keyplex)
imidacloprid (Marathon, various)
kaolin (novasource)
lambda-cyhalothrin (Scimitar, various)
malathion (various)
mineral oil/petroleum distillate (various)
neem oil (Ecoworks)
permethrin (Perm-Up)
phosmet (Imidan)
potassium laurate (Des-X, KOPA)
pyrethrin (Pyganic Dust)
sodium borate (Prev-Am)
spinetoram (XXPire)
spinosad (Conserve, Entrust)
thiamethoxam (Flagship 25WG)

scale

acephate (Acephate 90 WDG, Orthene, various)
acetamiprid (TriStar)
afidopyropen (Ventigra)
ammonium nonanoate (Axxe Broad Spectrum)
azadirachtin (Azatin O, Neemix 4.5, various)
bifenthrin (Talstar P, various)
buprofezin (Talus 70DF IGR)—Do not rotate with chitin synthesis inhibitors.
Burkholderia spp. (Venerate)
canola oil (Earth-tone Hort Oil)—Other oils include cottonseed.
carbaryl (Sevin)
chlorpyrifos (Vulcan)
Chromobacterium subtsugae (Grandevo)
cinnamaldahyde (Cinnacure)
cinnamon oil (Gargoil)
clothianidin (Arena)
cottonseed oil (Furious(
cyantraniliprole (Mainspring)
cyclaniliprole (Sarisa, Pradia)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
diazinon (Diazinon)
dimethoate (Dimate, Dimethoate)

dinotefuran (Safari)
emamectin (Mectinite)
esfenvalerate (Fenvastar EcoCap)
fenpropathrin/acephate (Tame/Orthene TR)
flonicamid (Aria)
flupyradifurone (Altus)
geraniol (Keyplex)
imidacloprid (Marathon, various)
lambda-cyhalothrin (Scimitar, various)
lime sulfur (Rex Lime)
malathion (various)
mineral oil/petroleum distillate (various)
neem oil (Nimbiosys, Rango)
phosmet (Imidan)
piperonyl butoxide (Evergreen)
potassium laurate (various)
pyrethrin (Pyganic Dust)
pyriproxyfen (Defiance)
sodium borate (Prev-Am)
soybean oil (Golden Pest)
spinetoram (Delegate)
spirotetramat (Kontos)
sulfoxaflor (Transform)
thiamethoxam (Flagship 25WG)

thrips

abamectin (Avid)
acephate (Acephate 90 WDG, Orthene, various)
acetamiprid (TriStar)
ammonium nonanoate (Axxe Broad Spectrum)
azadirachtin (Azatin O, Neemix 4.5, various)
Beauveria bassiana (Botanigard, Naturalis L)
bifenthrin (Talstar P, various)
Burkholderia spp. (Venerate XC)
canola oil/pyrethrin (various)
carbaryl (Sevin)
carbon dioxide (IGI Carbon Dioxide)
chlorfenapyr (Pylon, Piston)
chlorpyrifos (Vulcan)
Chromobacterium subtsugae (Grandevo)
cinnamaldehyde (Cinnacure)
cinnamon oil (Gargoil)
corn oil, peppermint oil (Circadian Sunrise)
cottonseed oil (Furious)
cyantraniliprole (Mainspring)
cyclaniliprole (Sarisa) WA only
cyclaniliprole/flonicamid (Pradia)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
diazinon (Diazinon)
dimethoate (Dimate, Dimethoate)
dinotefuran (Safari)
fenpropathrin/acephate (Tame/Orthene TR)
flonicamid (Aria)
flupyradifurone (Altus)
geraniol (Keyplex Ecotrol Plus)
gs-omega/kappa-HXTX-HV1A (SPEAR-Lep)imidacloprid (Marathon, various)
imidacloprid (Imicide)
Isaria fumosorosea Apopka strain 97 (Preferal Microbial Insecticide, PFR 97)
kaolin (Surround)

lambda-cyhalothrin (Scimitar, various)
malathion (various)
Metarhizium anisopliae (Met 52)
methiocarb (Mesurol)
mineral oil/petroleum distillate (various)
neem oil, clarified hydrophobic extract of (Triact, Trilogy)—Avoid tank mixes of oxythioquinox, captan, sulfur, chlorothalonil.
novaluron (Pedestal)
permethrin (Ambush, Pounce, Permethrin, various)
piperonyl butoxide (Evergreen)
potassium laurate (M-Pede)
pyrethrins (PyGanic Dust)
pyridalyl (Overture)
pyriproxyfen (Defiance)
sodium borate (Prev-Am)
soybean oil (Golden Pest Spray)
spinetoram (XXPire)
spinosad (Conserve, Entrust)
spirotetramat (Kontos)
sulfoxaflor (Transform)
tau-fluvalinate (Mavrik Aquaflow)
thiamethoxam (Flagship 25WG)

webworm

acephate (Acephate 90 WDG, Orthene, various)
azadirachtin (Azatin O, Neemix 4.5, various)
Bacillus thuringiensis aizaiwai (Xentari)
Bacillus thuringiensis kurstaki (Dipel, various)
Beauvaria bassania (Botanigard)
bifenthrin (Talstar P, various)
Burkholderia spp. (Venerate)
canola oil (Mighy, Pycana)
carbaryl (Sevin)
chlorpyrifos (Vulcan)
Chromobacterium subtsugae (Grandevo)
clothianidin (Arena)
cyantraniliprole (MainSpring)
cyclaniliprole (Pradia)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
diazinon (Diazinon, Adama)
diflubenzuron (Dimilin 25W)
dimethoate (AgriSolutions)
dinotefuran (Safari)
emamectin (Mectinite)
esfenvalerate (Asana, Zyrate)
geraniol (Keyplex Ecotrol Plus)
gs-omega/kappa-HXTX-HV1A (SPEAR-Lep)
lambda-cyhalothrin (Scimitar, various)
malathion (various)
methoxyfenozide (Intrepid)
mineral oil/petroleum distillate (various)
neem oil (Ecoworks, DeBug)
novaluron (Rimon)
permethrin (Ambush, Pounce, Permethrin, various)
piperonyl butoxide (Evergreen)
potassium laurate (M-Pede)
pyrethrin (Pyganic Dust)—Some products.
pyridalyl (Overture)
soybean oil (Golden Pest)
spinetoram (XXPire)

spinosad (Conserve, Entrust)

white pine weevil

acephate (Acephate 90WDG)
bifenthrin (Talstar P, various)
cyhalothrin (Declare)
dinotefuran (Safari)
imidacloprid (Marathon, various)
lambda-cyhalothrin (Drexel, LambdaStar)

whitefly

abamectin (Avid)
acephate (Acephate 90 WDG, Orthene, various)
acetamiprid (TriStar)
afidopyropen (Ventigra)
ammonium nonanoate (Axxe Broad Spectrum)
azadiractin
Beauveria bassiana (Botanigard, Naturalis L)
bifenthrin (Talstar P, various)
buprofezin (Talus 70DF IGR)
Burkholderia spp. (Venerate XC)
canola oil (Earth-tone Hort Oil)—Other oils include cottonseed, peppermint.
canola oil/pyrethrin (various)
chlorpyrifos (Vulcan)
Chromobacterium subtsugae (*Grandevo*)
cinnamaldehyde (Cinnacure)
cinnamon oil (Gargoil)
clothianidin (Arena)
corn oil (Circadian Sunrise)
cottonseed oil (Furious)
cyantraniliprole (MainSpring)
cyclaniliprole (Sarisa) WA only
cyclaniliprole/flonicamid (Pradia)
cyfluthrin (Decathlon 20WP)
cyhalothrin (Declare)
diazinon (Diazinon)
diflubenzuron (Adept)
dimethoate (Dimate, Dimethoate)
dinotefuran (Safari)
esfenvalerate (Fenvastar EcoCap)
etoxazole (Beethoven, Eschaton)
fenazaquin (Magus)
fenpropathrin (Tame 2.4EC)
fenpyroximate (Akari)
flonicamid (Aria)
flupyradifurone (Altus)
geraniol (Keyplex Ecotrol Plus)
gs-omega/kappa-HXTX-HV1A (SPEAR-T Liquid)
imidacloprid (Marathon, various)
imidacloprid/bifenthrin (Atera, Bithor)
Isaria fumosorosea Apopka strain 97 (Preferal Microbial Insecticide, PFR 97)
lambda-cyhalothrin (Scimitar, various)
malathion (various)
Metarhizium anisopliae (Met 52)
mineral oil/petroleum distillate (various)
neem oil (EcoWorks, Nimbiosys)
novaluron (Pedestal)
permethrin (Ambush, Pounce, Permethrin, various)
piperonyl butoxide (Evergreen)
potassium laurate (various)

potassium silicate (Sil-Matrix)
pymetrozine (Endeavor)
pyrethrin (Pyganic Dust)
pyrethrins/PBO
pyridaben (SanMite)
pyriproxyfen (Defiance)
sodium borate (Prev-Am)
soybean oil (Golden Pest)
spinetoram (XXPire)
spirotetramat (Kontos)—Systemic activity
sulfoxaflor (Transform)
tau-fluvalinate (Mavrik Aquaflow)
thiamethoxam (Flagship 25WG)

Biological Control of Nursery Pests

Biological treatments for use in commercial nursery applications			
Insect or mite	**Natural enemy**	**Species**	**Useful information**
aphid	predatory midge	*Aphidoletes aphidimyza*	Commercially available. Maggot-like larvae are voracious predators of aphids. Adults may go into diapause with low light or short days.
	parasitoid wasps	*Aphidius ervi, A. matricariae, A. colemani, Aphelinus abdominalis, Diaeretiella rapae, Lysiphlebus testaceipes, Trioxys pallidus*	Some species commercially available. Many parasitoids have preferred hosts
	hover flies		Maggot-like larvae are voracious predators of aphids. Pollen and nectar feeding adults are commonly seen around flowers.
	lady beetles ("ladybugs")	Many species including: *Hippodamia convergens, Harmonia axyridis, Coleomegilla maculata, Coccinella septempunctata*	Note: use of non-local, wild-harvested lady-beetles is discouraged due to potential movement of lady beetle pathogens and parasites.
	lacewings	*Chrysopa* spp., *Chrysoperla carnea, C. rufilabris, C. comanche*	Some species commercially available.
	minute pirate bugs	*Orius* spp.	Some species commercially available. Both adults and larvae are predators of small eggs, insects, and mites.
	soldier beetles	*Podabrus* spp., *Cantharus* spp.	Both adults and larvae are predators. They supplement their diet with nectar and pollen.
	big-eyed bugs	*Geocoris* spp.	Both adults and larvae are predators.
caterpillars	bacterial endotoxins Btk, Bta	*Bacillus thuringiensis kurstaki* (Dipel, various), *Bacillus thuringiensis azawai* (Zentari)	Formulated into commercially available microbial pesticides. Best used on young larval instars.

Biological treatments for use in commercial nursery applications			
Insect or mite	**Natural enemy**	**Species**	**Useful information**
	viruses	Naturally occurring viruses including granulosis virus and nucleopolyhedrosis virus.	Some strains are commercially available for specific pests such as codling moth.
	parasitoid wasps of eggs	*Trichogramma minutum , T. bactrae, Trichogramma platne, T. brassicae, T. pretiosum, T. platneri*	Some species are commercially available.
	parasitoid wasp of larvae	Many species, particularly in the families: Braconidae, Ichneumonidae	Adult wasps often feed on nectar, insectary plants may enhance activity.
	parasitic flies	Several species in the family Tachinidae	
	ground beetles	Several species in the family Carabidae	
	lacewings	*Chrysopa* spp., *Chrysoperla carnea, C. rufilabris, C. comanche*	Some species are commercially available
leafminer	parasitic wasps	*Diglyphus* spp.	Commercially available. Used for management of *Liriomyza* spp.
		Dacnusa sibirica	Commercially available. Used for management of *Liriomyza* spp.
	entomopathogenic nematodes	*Steinernema feltiae*	Foliar applications in greenhouses
peach twig borer	braconid wasp	*Macrocentrus ancylivorus*	
	chalcid wasps	*Copidosoma (=Paralitomastix) varicornis, Hyperteles lividus*	
	itch mite	*Pyemotes ventricosus*	
root weevil	pathogenic nematodes	*Heterorhabditis heliothidis, H. medidis, Steinernema carpocapsae, S. feltiae, S. kraussei, S. riobravis*	
	carabid beetles	several species	
	predatory mites	*Neoseiulus californicus, N. fallacies, Amblyseius hibisci,*	

Biological treatments for use in commercial nursery applications			
Insect or mite	**Natural enemy**	**Species**	**Useful information**
spider mite		*Phytoseiulus persimilis, P. macrophililis, P. longipes, Galendromus (Metaseiulus) occidentalis*	
	minute pirate bugs	*Orius* spp.	
	predatory lady beetle	*Stetorus* spp.	
	predatory midge	*Felitiella* spp.	
Note: Adapted from Amy J. Dreves, Leonard Coop, and Mario Ambrosino.			

Aphids have many natural enemies including parasites and predators. Some of the natural enemies can be encouraged with conservation, including use of selective pesticides, and habitat modification. Augmentation of natural enemies generally occurs most successfully in protected environments. More information on specific natural enemies can be found in the Aphid Natural Enemy Table. Additionally, aphids may also experience epizootics from both naturally occurring fungi such as *Entomophthora* spp. and application of commercially available microbial pesticides such as *Beauveria bassiana* (Botanigard, Naturalis L) and *Paecilomyces fumosoroseus* (PFR 97)

For more information, see materials listed for aphid in:

Chemical Control of Nursery Pests

Caterpillars—Soft-bodied caterpillars present a vulnerable target for parasitic wasps such as ichneumonids, braconids and chalcid and parasitic flies called tachinids. These wasps and flies use an ovipositor (ovi = egg, positor = placer) to insert their eggs onto or through the soft cuticle of the caterpillars. The eggs hatch to become internal or external parasites.

Root weevils—More information on the use of beneficial entomopathogenic nematodes *see*: PNW Nursery IPM: Entomopathogenic Nematodes: http://oregonstate.edu/dept/nurspest/entomopathogenic_nematodes.htm

Links:

Suppliers of Biological Control Agents:

- Suppliers of Beneficial Organisms in North America—http://www.cdpr.ca.gov/docs/pestmgt/ipminov/bensup.pdf
- Association of Natural Biocontrol Producers—http://www.anbp.org/
- Biocontrol of Root Weevils—http://oregonstate.edu/dept/nurspest/Biocontrol_%20root%20weevils.html
- Biological Control of Twospotted Mite—http://oregonstate.edu/dept/nurspest/two-spottedmite.htm
- Conservation of Biological Control Agents:
- Koppert Biological Systems—http://www.koppert.nl/Side_effects.html
- Biobest Biological Systems—http://www.biobest.ca/

Hosts and Pests of Nursery Crops

Alder *(Alnus)*—Alder flea beetle

Macrohaltica ambiens and others

Pest description and crop damage Adults are dark shiny blue and about 0.25 inch long. Larvae are dull brown to black and about 0.25 inch long at maturity. They feed on and skeletonize foliage of alder, poplar, and willow. Both adults and larvae feed on the foliage.

Biology and life history Adults become active in spring. Larvae usually are present in June and July. Populations of alder flea beetles vary year-to-year. In outbreak years, these beetles can cause substantial defoliation but rarely enough to effect long-term health of the trees. Occasionally applications are necessary in nurseries.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 228).

Pacific Northwest Nursery IPM (http://oregonstate.edu/dept/nurspest/alder%20flea%20beetle.htm)

Alder *(Alnus)*—Aphid

See:
Common Pests of Nursery Crops

Alder *(Alnus)*—Leafminer

Fenusa dohrnii

See:
Common Pests of Nursery Crops

Pest description and crop damage The adult insect is a black sawfly about 0.25 inch long. The larvae are small, and light colored. The larvae feed between epidermal layers, creating large dark blotches in the leaves. After the insects leave, the affected areas turn light brown and crinkle. Aside from the effects on the appearance of the foliage, some defoliation and weakening of the tree can occur.

Biology and life history The insect overwinters in the soil as a pupa. Adults first appear in spring, when leaves are partly formed. The females lay eggs on upper leaves, after the eggs hatch they mine out the middle layer of the leaf. Several mines may combine to form a blotch. After 2 to 3 weeks, the larvae drop to the ground and pupate. There are normally two generations per year.

Management—chemical control

See:
Chemical Control of Nursery Pests

Alder *(Alnus)*—Western tent caterpillar

Malacosoma californicum

Pest description and crop damage The western tent caterpillar attacks a wide variety of plants besides hawthorn, including alder, ash, birch, cottonwood, and willow, as well as fruit trees and roses. The adult moths are stout, light to darker brown, and are active in early to midsummer. They are attracted to lights at night. Larvae of the western tent caterpillar are hairy, dull yellow-brown, with rows of blue and orange spots on the body. Eggs of these moths are laid on twigs or buildings in masses. These are brown to gray in color, about 0.0625 inch long, and look like Styrofoam®. The larvae feed in large groups on foliage of host plants and can do significant damage by defoliation. Larvae of western tent caterpillars build large silken tents over leaves on which they feed. Larvae can totally defoliate small trees, which may not kill them but reduces growth and makes the trees more susceptible to diseases or poor weather. Healthy trees usually will grow new leaves by midsummer.

Scouting and thresholds Look for egg masses on twigs or other overwintering sites. Masses of young larvae are identified easily in early spring.

Management—biological control

See:
Biological Control of Nursery Pests

Tent caterpillars have many natural enemies. Some birds eat the caterpillars, and small mammals consume the pupae. The larvae of a tachinid fly parasitizes the caterpillars.

Management— cultural control

Overwintering egg masses can be removed and destroyed when practical.

Management—chemical control

Dormant-season spray oil spray

Apply with enough water to cover the entire tree thoroughly. Apply in delayed-dormant period to destroy overwintering egg masses.

Growing-season spray

Spray in spring after overwintering eggs hatch, at about the time leaves are 0.75 to 1 inch long. Control is much more effective if sprays are applied when larvae are small.

See:

Chemical Control of Nursery Pests

For more information

PNW Nursery IPM: Western tent caterpillar (http://oregonstate.edu/dept/nurspest/tent_caterpillars.htm)

Andromeda *(Pieris japonica)*—Weevil

See:

Common Pests of Nursery Crops

Apricot, flowering *(Prunus)*—Peachtree borer

Synanthedon exitiosa

Pest description and crop damage Peachtree borer is native to North America and common in the Northwest. The adult is a metallic blue-black, clear-wing moth. The male moth may have bands of light yellow on the abdomen, which makes it resemble a wasp. The female has an orange band around the abdomen. Full-grown larvae are 1 inch long and whitish with a brown head. The larvae burrow into the bark of the crown and feed on the cambium. Feeding is restricted to an area a few inches above and below the soil line. Young trees can be completely girdled and killed. Older trees rarely are girdled, but the feeding reduces vigor and makes them vulnerable to other pests and diseases. Infested trees bleed frass-infested gum during the growing season.

Biology and life history The borer overwinters as a larva on or under the tree bark, usually below ground. As temperatures rise above 50°F in the spring, the larva resumes feeding on the tissues under the bark. At maturity in May and June, the larva pupates. Adult moths emerge beginning in June and continue through September. Eggs are laid quickly after mating. Young larvae hatch after 8 to 10 days and bore immediately into the base of the tree.

Scouting and thresholds Pheromone traps are available for this peachtree borer. This insect can do substantial damage if not controlled: one larva can kill a small tree. Entry holes and borer damage greatly affect marketability; action thresholds are very low. Prevention is key.

Management— cultural control

Rogue and destroy infested plants.

Mating Disruption Pheromone mating disruption (Isomate P) at 100-250 dispensers/a. Dispensers must be placed in trees before first moth flight. Flight is usually from late June through September. If mating disruption is used, monitor blocks with traps baited with peachtree borer lures at 1 trap/2.5 a. If one or more moths are caught, a conventional insecticide application may be required.

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply in June and repeat at 3- to 4-week intervals throughout summer.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 258-261).

PNW Nursery IPM: Peach Tree Borer Mating Disruption (http://oregonstate.edu/dept/nurspest/peach_tree_borer.htm)

Apricot, flowering *(Prunus)*—Peach twig borer

Anarsia lineatella

Pest description and crop damage Peach twig borer is a European insect first found in California in the 1880s. It is a major pest of apricots, peaches, plums, and prunes. There are no native hosts outside the orchard. The adult is a steel-gray moth with white and dark scale, about 0.33 to 0.5 inch long. The larva is a caterpillar, approximately 0.5 inch long, with a dark brown head and distinctive, alternating light and chocolate-brown bands on the body. The pupa is smooth and brown. The larva of the borer causes injury to fruit and trees. Feeding on the buds and twigs occurs early in the season, after which the larva bores into the shoots, causing a characteristic “flagging” or wilting of the new growth. Later generations of larvae feed on shoots or fruit, disfiguring the fruit.

Biology and life history The borer overwinters as an immature larva in tunnels constructed in the crotches of twigs and branches. These overwintering sites can be identified by the small chimneys of frass and wood chips produced by the feeding of the larvae. Larvae become active at the pink bud stage and emerge to feed on buds and young leaves before boring into a shoot. These larvae eventually leave the mined shoot to pupate. Adults then emerge in mid- to late May. Eggs are laid on fruit, shoots, or undersides of leaves. Eggs are yellowish-white to orange. The eggs hatch, and these larvae feed and mature on shoots and immature fruit. The next adult flight is in mid-July. Part of the larvae from this flight overwinter, the rest produce a partial third flight.

Scouting and thresholds Check for overwintering sites on small trees. Otherwise, examine shoots in late April or early May. Wilted shoots are easy to spot: these should be opened check for larvae.

Management—biological control

A tiny parasitic wasp is active in orchards at shuck fall and parasitizes eggs.

Management—cultural control

Cut out mined shoots below the wilted area to eliminate larvae. Overwintering larvae may be found under thin bark in branch crotches and destroyed. Look for a buildup of chewed bark and frass (excrement).

Management—chemical control

See:
Chemical Control of Nursery Pests

Do not apply to bloom unless pollinator safe material. Apply 1 to 2 gal spray mix per tree. Best times to spray are prebloom and petal fall stages.

For more information

PNW Nursery IPM: Peach twig borer (http://oregonstate.edu/dept/nurspest/borer_damage_plums.htm)

Apricot, flowering *(Prunus)*—Spider mite

Tetrahychus spp.

See:
Common Pests of Nursery Crops

Arborvitae *(Thuja)*—Borer

Flat-headed borers *(Chrysobothris nixa)*
Shothole borers *(Phloeosinus punctatus)*

Pest description and crop damage Flatheaded borers are pests of many different trees and shrubs. The 0.5 inch adults are either brown to metallic gray or black with red or orange markings, depending on species. Larvae are whitish to pale yellow and about 0.5 inch long when fully developed. Just back of the head is a broad, flat enlargement giving a “flat-headed” appearance. Individual plant damage can be one-sided depending on the site of feeding. Most damage occurs near the base of the plant, commonly at the soil line. Flatheaded borers tunnel extensively in the shallow, cambial tissue. Shothole borer adults are brown beetles less than 0.08 inch long. Larvae feed beneath the bark and may girdle the trunks and branches of trees. The larvae of the shothole borer feed beneath the bark on the trunk, leaving characteristic “shothole” symptoms (tiny holes in the bark) when they emerge. Larval feeding also may be associated with weeping sap on the trunk. Young, recently planted trees are most susceptible.

Scouting and thresholds Watch for depressions in the bark or cracks through which frass may be seen. Entry holes and borer damage greatly affect marketability; action thresholds are very low. Prevention is key.

Management—cultural control

As the borer is attracted to weakened trees, the best control is to keep trees healthy. Avoid wounding plants, and follow good pruning, watering, and fertilization practices. Keeping weeds, grass, and trash from the base of the trees makes it easier to detect and remove borers. Rogue and destroy infested plants.

Management—chemical control

See:
Chemical Control of Nursery Pests

Chemical management is rarely economic except for high value hosts. Apply as a protective trunk spray prior to adult flight in the summer.

For more information

PNW Nursery IPM: Flatheaded cedar borer (http://oregonstate.edu/dept/nurspest/Flatheaded_cedar_.htm)

Arborvitae *(Thuja)*—Cypress tip moth

Argyresthia cupressella

Pest description and crop damage The adult cypress tip moth (cypress tip miner) is silver-tan and approximately 0.125 inch long. The larvae are green, about 0.125 inch long. The cocoon is a white, somewhat papery structure made in dead or living foliage. The larvae tunnel in the growing points of the 1- and 2-year-old shoot tips. Damage typically is limited to the tips of twigs. The exit holes are dark and may resemble symptoms of leaf blight, a fungal disease. Foliage does not discolor in the affected areas until late winter. After this, the brown, dead twigs break off readily. Cultivars of *Juniperus chinensis*, *J. virginiana*, and *J. sabina* also are affected. The entire plant can appear brown in a severe infestation, and repeated infestations cause dieback.

Biology and life history Adult moths appear on plants around May–June. Eggs are laid on the shoot tips of host plants. The larvae tunnel under the leaf scale and feed on the foliage until the following spring. Larvae leave the mines and spin a white cocoon in which they pupate in spring. They have been found emerging and spinning cocoons in mid-April during 2004. Adult moths emerge from early May until late June with a peak in late May and early June. There is one generation a year.

Management—cultural control

American arborvitae *(Thuja occidentalis)* is very susceptible to infection. Western redcedar *(Thuja plicata)* is very resistant.

Management—chemical control

Sprays target adults from late June to August.

abamectin
acephate—Washington and Oregon only.
azadirachtin
bifenthrin
carbaryl
chlorpyrifos.
clothianidin
cyfluthrin
dinotefuran
imidacloprid
lambda-cyhalothrin

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 42).

PNW Nursery IPM: Cypress tip moth (http://oregonstate.edu/dept/nurspest/cypress_tip_moth.htm)

Arborvitae *(Thuja)*—Root weevil

See:
Common Pests of Nursery Crops

Arborvitae *(Thuja)*—Scale

Includes

Matsucoccus spp.
Pine needle scale *(Chionaspis pinifoliae)*

See:
Common Pests of Nursery Crops

Pest description and crop damage Pine needle scale and Matsucoccus scale are among the scale that attack arborvitae. Scale are closely related to aphid, mealybugs, and whiteflies and, like these insects, also have piercing–sucking mouthparts. Large populations of scale can devitalize plants and retard growth, as well as discolor the foliage. Severe infestations can kill twigs. Large quantities of honeydew are produced by soft scale, which makes leaves and fruit shiny and sticky. Black sooty mold fungus may grow on this, giving the plants a dirty, sooty appearance.

Arborvitae *(Thuja)*—Spider mite

Oligonychus ununguis

See:
Common Pests of Nursery Crops

Ash *(Fraxinus)*—Aphid

Several species, includes woolly ash aphid

See:
Common Pests of Nursery Crops

For more information

PNW Nursery IPM: Woolly ash aphid (http://oregonstate.edu/dept/nurspest/woolyashaphid/introduction.htm)

Ash *(Fraxinus)*—Scale insect

Numerous species

See:
Common Pests of Nursery Crops

Aspen *(Populus tremuloides)*—Leaf blotchminer

Phyllonorycter tremuloidiella

See:
Common Pests of Nursery Crops

Pest description and crop damage Adults of this insect are tiny moths. Early instar larvae are flat. The larvae produce blotched mines, which may be more visible on one side of the leaf. Miners spin silk across the leaf surface, which dries and shrinks to create a ridge over the mine. The larvae feed initially on sap, then feed inside the leaves on tissue during summer. There may be more than one generation per year.

Management—cultural control

Aspen and cottonwood are very susceptible. Plant resistant trees where serious problems exist. Remove affected leaves as they are seen.

Management—chemical control

See:
Chemical Control of Nursery Pests

Azalea *(Rhododendron)*—Azalea bark scale

Eriococcus azaleae

Pest description and crop damage This scale superficially resembles mealybugs in appearance. Mature female scale are about 0.125 inch long and appear like white cottony sacs, often located on twigs and stems of azalea, especially in branch crotches. The scale feeds on the bark of twigs and stems and has a devigorizing effect. Large quantities of honeydew are produced, which makes leaves shiny and sticky. Sooty mold fungus may grow on this, giving the plants a dirty, sooty appearance. Honeydew also can collect on decks and other landscape surfaces and become a significant nuisance.

Biology and life history The scale overwinters as an adult, and lays eggs in the spring. The young scale (called "crawlers") are the mobile form of most species, and these migrate through the foliage to feed. As they feed and mature, they form a protective shell over their bodies. Crawlers are the most vulnerable life stage of most scale species. Adults of most species are well protected from predators and pesticide applications under the protective shell which gives them their name. There is usually one or possibly two generations per year.

See:
Arborvitae *(Thuja)*—Scale

For more information

PNW Nursery IPM: Azalea bark scale (http://oregonstate.edu/dept/nurspest/azalea_bark_scale.htm)

Azalea *(Rhododendron)*—Azalea leafminer

Caloptilia azaleella

See:
Common Pests of Nursery Crops

Pest description and crop damage The adult insect is a golden yellow moth about 0.5 inch long. The larvae are small, pale yellow to green caterpillars, 0.125 to 0.25 inch long. The larvae mine leaves during the early part of their development. During later stages of their development, they are also responsible for rolling leaves and chewing holes in them.

Biology and life history The insect overwinters as a pupa in rolled leaves, or possibly as a larva in a mined leaf. After the adult moth emerges, eggs are laid singly on the underside of leaves. The larvae emerge and mine into the leaf, causing the mined tissue to turn brown. Then they emerge from the leaf and roll it over their bodies with silk to feed. Later, they select an undamaged leaf, roll it up, and pupate in it. The adult moth emerges about a week later. There may be two to three generations per year.

Scouting and thresholds Observe new early-spring growth for rolled leaves and feeding damage.

Management—biological control

Very low temperatures in winter significantly reduce overwintering populations. Spiders and parasitic/predatory insects greatly reduce populations throughout the year.

Management—cultural control

Hand-pick larvae if found. Removal of overwintering sites, such as rolled leaves on the ground or plastered to plants, can reduce next year's population.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply first just after blooming. Apply again at 2 to 3 week intervals until control is complete. Applications in late summer and early fall have given exceptional cleanup for the following season.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 202).

Azalea *(Rhododendron)*—Lace bug

Stephanitis pyrioides

Pest description and crop damage Overwinters in egg stage. Eggs are laid in the midrib on the underside of leaves. A new introduction to the PNW, little is known about the phenology of azalea lace bug in this region. Azalea lace bug eggs first hatch in early summer, with 2-3 generations in

the PNW likely. Nymphs, the young immature lace bugs, are nearly translucent and light yellowish-green when small. As they age, they darken and become spiny. The adult nymphs are around 0.25 inch long, with wings that are slightly colored with white and black patterns in a window pane effect and quite sculptured. The head capsule is round and swollen-looking from the side.

Lace bugs have piercing/sucking mouth parts. The initial damage shows up as light yellow stippling on the surface of the leaves. Higher populations can cause more severe damage on azaleas, causing the leaves to turn nearly white. On rhododendrons, severe damage may look like iron chlorosis with yellow leaves and green veins. Lace bugs leave small black fecal spots on the underside of leaves. Exuvia, or cast skins, are also often present.

Management—biological control

There are a range of predators that feed on azalea lace bug including azalea plant bug, tree crickets, earwigs, green lacewings, minute pirate bugs, and spiders. A Rutgers publication mentions one nursery study investigating augmentation with green lacewing larvae against newly hatched azalea lace bug nymphs resulted in 79-97% control.

Management—cultural control

Drought stressed plants are more susceptible to lace bug attack. Azaleas in the sun are reported to be nearly twice as likely to be infested. There are azaleas that show some resistance to azalea lace bug. High pressure water applications directed at leaf underside may dislodge the wingless nymph stages.

Management—chemical control

See:

Chemical Control of Nursery Pests

Insecticidal soaps and oils must directly contact the insects to control them and are most efficacious on newly hatched nymphs and can have high levels of control if used correctly. Horticultural oil can also smother the egg stage. Neem-based products act as anti-feedants, insect growth regulators, and repellants. Early season control is very important with these tools.

The egg stage is embedded in the plant material and thus protected from most control (except for horticultural oils). Most of the remaining chemical options act either as contact insecticides such as the pyrethroids or carbaryl or have systemic activity such as acephate or the Neonicotinoids. Contact insecticides and some of the systemic insecticides may have a detrimental impact on beneficial insects. Timing of the neocicotinoid insecticides generally is either a foliar application shortly before the egg hatch (6-8 weeks) or applied as a soil drench in the late fall.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 424).

PNW Nursery IPM: Azalea lace bug (http://oregonstate.edu/dept/nurspest/azalea_lace_bug.htm)

Azalea *(Rhododendron)*—Obliquebanded leafroller

Choristoneura rosaceana

Adults of the obliquebanded leafroller are bell-shaped, up to 1 inch long, tan to brown, with broad bands on the wings. The larvae are green caterpillars with a light brown to black head. As the name leafroller implies, the larvae roll and tie leaves together for shelter and feeding. They thrash about violently when disturbed, and may drop from the leaf suspended by a silken thread. Their feeding on growing points on young plants can promote undesirable branching.

Biology and life history The obliquebanded leafroller overwinters as immature larvae under the bark on scaffold branches of a variety of host plants. Larvae may feed during warm periods in winter, but become active in spring with onset of new growth. They feed for several weeks, then pupate in rolled leaves. Adult moths emerge in late June or early July. These lay eggs for the second generation. The second generation hatches in early July and does the most damage.

Scouting and thresholds Start sampling for leafrollers in mid-April. Examine the terminal clusters for tightly rolled leaves and feeding damage on new growth.

Management—biological control

See:

Biological Control of Nursery Pests

Very low temperatures in winter significantly reduce overwintering populations of larvae. Spiders and parasitic wasps, as well as predators like the brown lacewing, greatly reduce leafroller populations throughout the year.

Management—cultural control

Hand-pick rolled leaves containing larvae or pupae. Removal of overwintering sites, such as rolled leaves on the ground or plastered to plants, can reduce next year's population.

Management—chemical control

See:

Chemical Control of Nursery Pests

Several applications may be needed during season. Do not apply to bloom.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 216).

Azalea *(Rhododendron)*—Root weevil

Includes Obscure root weevil *(Sciopithes obscurus)* and *Otiorhynchus* spp.

See:
Common Pests of Nursery Crops

Azalea *(Rhododendron)*—Spider mite

Southern red mite *(Tetranychus* spp.*)*

See:
Common Pests of Nursery Crops

Bamboo *(Bambusa* and others*)*—Aphid

Takecallis arundinaria

Pest description and crop damage Small, light-green aphid, banded antennae.

See:
Common Pests of Nursery Crops

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 312).

Bamboo *(Bambusa* and others*)*—Bamboo spider mite

Stigmeopsis (Schizotetranychus) celarius, Stigmeopsis longus

See:
Common Pests of Nursery Crops

Pest description and crop damage Bamboo mites have a flattened body, which is straw-colored to greenish yellow with small blackish green spots. First impression is that leaves are under attack by a leafminer. The mite feeding on the plant cell contents leaves a distinct pattern of damage visible on both sides of the leaf. The feeding site damage is yellow and may look similar to variegation. Preferred bamboo hosts for this mite include the genera *Sasa*, *Indocalamus, Phyllostachys, and Pleioblastus*.

Biology and life history These mites form colonies on the underside of the leaves and live under a densely woven web. Generally the mites remain under the web to feed and lay eggs, leaving to defecate in black fecal piles slighted removed from the nest. Adults and nymphs can sometimes be found outside the webbing, particularly as they begin to form new nests. Multiple males and females can be found in the web nests and often many webbed nests will form alongside each other running down the underside of the bamboo leaves. There are many generations per year for *S. celarius*.

Management—biological control

The predator mite *Neoseiulus fallacis* has been used successfully to control bamboo mite. The keys to the successful use of this mite are good scouting and releasing the mite at the proper threshold. Releases are more effective at low populations of the spider mite. These low levels of pests are not usually noticed without a rigorous scouting program. This particular predator mite requires 80% humidity, easily found in the canopy of bamboo grown in the Northwest. *N. californicus* may work in dryer conditions.

Management—cultural control

Bamboo mites only feed on bamboo and infestations can be avoided by screening all new material for the mites. Quarantine all new material to avoid spread of bamboo mites to existing bamboo nursery stock. Severe infestations can be treated by cutting down all cane growth on infested plants and burning or otherwise disposing of the foliage. The remaining foliage then can be treated more effectively for mites. Although severe, this treatment may be the only practical solution for heavily infested sites, particularly where chemical application presents difficulties.

USDA Agriculture Handbook 193 mentions the use of hot water treatment for dormant rhizomes to eliminate mites. It suggests immersing them for 10 minutes in hot water at 50ºC (122ºF), then heeling into sand or sawdust and keeping them cool until planting time in the spring.

Management—chemical control

See:
Chemical Control of Nursery Pests

The nature of the webbing and protection it gives mites suggests the need for power equipment so that material can reach mites under webbing. Add a spreading surfactant, recommended by some labels (including bifenazate), because bamboo leaves are difficult to wet.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 474).

PNW Nursery IPM website: Bamboo Mite IPM (http://oregonstate.edu/dept/nurspest/Bamboo/bamboomite.htm)

Barberry *(Berberis)*—Lecanium scale

Lecanium spp.

See:

Common Pests of Nursery Crops

Pest description and crop damage Lecanium scale are about 0.125 inch in diameter and vary from red to dark brown in color. They are oval and raised, resembling small helmets or bumps on branches, stems, and the underside of leaves.

Biology and life history Lecanium scale overwinters as an immature scale or a fertilized female on twigs and branches. They resume feeding in the spring, and eggs are laid underneath the scale in May–June. The eggs remain under the scale until hatching in early summer. The young scale are yellowish brown and flattened. These migrate to the undersides of leaves to feed. Young scale also can be dispersed by wind, rain, irrigation, or by the movement of people and machinery. After 4 to 6 weeks on the leaves, the young return to the stems and twigs to feed, mate, and overwinter. There is one generation per year.

Management—chemical control

Apply in July, August, or early September to control crawlers.

See:

Chemical Control of Nursery Pests

Beech *(Fagus)*—Aphid

Several species

See:

Common Pests of Nursery Crops

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 296).

PNW Nursery IPM: Woolly beech aphid (http://oregonstate.edu/dept/nurspest/woollybeechaphid.htm)

Birch *(Betula)*—Aphid

Includes *Euceraphis betulae*

See:

Common Pests of Nursery Crops

Pest description and crop damage Soft-body, greenish aphid leave sticky secretion on leaves and under trees.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 296).

Birch *(Betula)*—Birch leafminer

Fenusa pusilla

See:

Common Pests of Nursery Crops

Pest description and crop damage Adult insect is a small (0.125 to 0.375 inch) black sawfly. Mature larvae are flattened and may be up to 0.5 inch long. The larvae emerge and feed in leaf tissues, leaving blotch-shaped or winding brown mines. Repeated severe infestations may result in decline of trees. Vigorous gray, white, and paper birches are attacked most commonly.

Biology and life history The adult sawfly lays eggs in new leaves. Larvae drop to the ground and pupate in the soil for 2 to 3 weeks before emerging as adults. There may be up to four generations per year, depending on length of growing season.

Management—cultural control

Pinch leaves to kill larvae in minor infestations in small trees. Plant resistant species and cultivars, which include *Betula costata, B. davurica, B. maximowicziana, B. utilis var jacquemontii, B. nigra, B. schmidtii*, and the varieties ‘Crimson Frost’ and ‘Purple Rain’.

Management—chemical control

See:

Chemical Control of Nursery Pests

Spray when first leaves are fully formed, usually about the first of May. Spray again from mid-June to mid-July.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 128).

Birch *(Betula)*—Bronze birch borer

Agrilus anxius

Pest description and crop damage Adult is an olive-brown beetle with a blunt head and a tapering body about 0.5 inch long. Larvae are flatheaded borers. They grow to about 1 inch long and are creamy to white in color with a head wider than the body. The larvae bore into the branches or trunk after hatching and bore winding galleries along the cambial layer (between the wood and the bark). The galleries may heal, with swelling showing on the outside of the tree (lumpy bark), or may girdle and kill branches or trunks. Leaves may be yellow (chlorotic) as a result. The adults may feed on

leaves, but cause little damage. Bronze birch borers attack trees weakened by age, environmental stresses, or previous insect attacks. Susceptible birch species include *B. papyrifera, B. pendula,* and *B. populifolia*. Ornamental cutleaf varieties of birch seem particularly susceptible to attack by this borer.

Biology and life history The insect overwinters as a larva in the tree. As the weather warms in spring, the larvae resume feeding. They pupate in the tree, then the adult insect chews a D-shaped hole in the bark to emerge, starting in late spring. They lay their eggs in bark cracks or under flaps of bark. The larvae hatch and bore immediately through the bark to feed on the vascular tissues. The life cycle takes 1 to 2 years to complete.

Scouting and thresholds Entry holes and borer damage greatly affect marketability, action thresholds are very low. Prevention is key.

Management—cultural control

Borers are less likely to attack healthy trees. Remove nearby infested trees immediately. Keep trees vigorous with proper watering, fertilizing, and other cultural practices. Plant resistant varieties and species, which include *B. lenta, B. nigra* (including Heritage), and *B. platyphylla.*

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply materials to the trunk and lower limbs. Avoid contacting foliage. Apply generally in late spring or when adults are active. Preventative treatments with a systemic Neonicotinoid have worked in some areas.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 272).

PNW Nursery IPM: Bronze birch borer (http://oregonstate.edu/dept/nurspest/bronze_birch_borer.htm)

Birch *(Betula)*—Oystershell scale

Lepidosaphes ulmi

See:

Common Pests of Nursery Crops

Pest description and crop damage The mature scale is approximately 0.125 inch long, hard-shelled, brownish or gray, and usually elongated like an oyster or mussel shell. Oystershell scale are found on trunks, branches, and twigs of many broadleaf deciduous plants. They occur less frequently on the leaves and other plant parts. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Scale are closely related to aphid, mealybugs, and whiteflies and, like these insects, also have piercing–sucking mouthparts. Large populations of scale can devitalize plants and retard growth. Infested plants may show off-color foliage. Severe infestations can kill twigs.

Biology and life history Oystershell scale overwinter as eggs beneath the shell of the female scale. The young scale (called “crawlers”) move to feeding sites in late spring or early summer. Young scale also can be dispersed from plant to plant by wind, rain, irrigation, or by the movement of people and machinery.

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 370).

Boxwood *(Buxus)*—Boxwood leafminer

Monarthropalpus buxi

See:

Common Pests of Nursery Crops

Pest description and crop damage The adult is a small (0.1 inch) orange to yellow fly which emerges in early May. The larval stage of the boxwood leafminer is a small yellow to green maggot found inside the mined leaves. Leafminers feed by removing green tissue from between the upper and lower leaf surfaces. Feeding by leafminers can be detected by the presence of yellow to brownish blotch-like mines or by a blistered, thickened appearance of the leaves. Damage is mainly aesthetic, but repeated severe infestations may damage shrubs.

Biology and life history The insect overwinters as a larva in the mined leaves. In spring, it becomes active and grows rapidly. The orange pupae can be seen clinging to the leaf before the adult fly emerges. Female flies lay eggs on the upper surface of the current season’s growth. The larvae hatch and mine the leaves through the summer. There is one generation per year.

Management—cultural controls

Pick off infested leaves or clip out infested terminals. Plant resistant varieties, which include ‘Suffruticosa’, ‘Pendula’, and ‘Argenteo-variegata’.

Management—chemical control

abamectin (Avid)—Apply when adults are laying eggs.

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 204).

PNW Nursery IPM: Boxwood leafminer (http://oregonstate.edu/dept/nurspest/boxwood_leafminer.htm)

Boxwood *(Buxus)*—Boxwood psyllid

Psylla buxi

Pest description and crop damage The greenish, aphid-like adult psyllids are about 0.125 inch long. The adults jump, and can even bite, although this is not serious. The immature psyllids (nymphs) are covered with a white, waxy secretion that gives them a cottony look. The nymphs feed on the developing buds and new growth. The presence of the boxwood psyllid is indicated by the cupping of leaves at the tips of terminals. Buds in cupped leaves often are dead. Honeydew, a shiny, sticky material produced by the insects, may be present. The honeydew may become covered with a growth of black sooty mold.

Biology and life history The insect overwinters as spindle-shape orange eggs under bud scale on boxwood. As the buds begin to open, the eggs hatch and the nymphs begin to feed. Adults can be found by late May. The adult females lay their eggs under the bud scale. There is only one generation per year.

Management—biological control

Ladybird beetles, lacewings, and parasitic wasps are all effective controls for this pest. Avoid the use of broad-spectrum sprays which would disrupt these controls.

Management—cultural control

English boxwood (Buxus sempervirens) is reportedly less susceptible.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 290).

PNW Nursery IPM: Boxwood psyllid (http://oregonstate.edu/dept/nurspest/boxwood_psylla.htm)

Boxwood *(Buxus)*—Boxwood spider mite

Eurytetranychus buxi

See:
Common Pests of Nursery Crops

Pest description and crop damage The adult is a small greenish to brown mite. Their feeding causes small whitish, yellowish, or bronze streaks that look like pin scratches on the upper leaf surface. Heavy infestations can cause premature leaf drop. Damage is common throughout the Willamette Valley of Oregon.

Scouting and thresholds Observe the leaves for mites and webbing and check for the number of pest and predator mites. Sufficient biological control usually is achieved by midsummer.

For more information

PNW Nursery IPM: Boxwood spider mite (http://oregonstate.edu/dept/nurspest/boxwood_spider_mite.htm)

Boxwood *(Buxus)*—Scale

Includes holly scale (Dynaspidiotus britannicus)

See:
Common Pests of Nursery Crops

Pest description and crop damage Scale covering is light brown to tan, 0.63 inch in diameter. They devitalize plants and spot leaves.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply to control the immature crawler stage, usually in late spring to early summer. Scout for crawlers and gather life history data. Oils are effective early to late spring, but oil spray may injure tender foliage.

Camellia *(Camellia)*—Black citrus aphid

Toxoptera aurantii

See:
Common Pests of Nursery Crops

Pest description and crop damage Small black aphid on new growth or on winter buds. Infestations may be severe in any season and are often a problem on plants growing in protected places.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 302).

Camellia *(Camellia)*—Brown soft scale

Coccus hesperidum

See:
Common Pests of Nursery Crops

Pest description and crop damage Brown soft scale are yellowish to dark brown insects (adults are usually darker). They are found mainly on twigs, although young scale also may be found on the foliage, typically on the underside of leaves. Soft scale produce large amounts of honeydew, a sweet, sticky material which may become covered with a growth of dark sooty mold. Heavy scale infestations also can cause plants to become yellowish and wilted in appearance.

Management—chemical control

See:
Chemical Control of Nursery Pests

Camellia *(Camellia)*—Cottony camellia scale

Pulvinaria floccifera

See:
Common Pests of Nursery Crops

Pest description and crop damage The cottony camellia scale is a flat, brownish or yellowish insect. Crawlers (young scale) feed on the underside of leaves. Cottony camellia scale produce large amounts of honeydew, a sweet sticky material which is often covered with a growth of black sooty mold. Foliage with scale infestations may turn yellowish or pale in color. The cottony camellia scale also is found on yew and holly.

Biology and life history The scale overwinter on twigs or evergreen leaves as nymphs. In the spring, adult females lay cottony egg masses about 0.25 inch long on the underside of leaves. The eggs hatch, and the crawlers settle on the leaves to feed. There is one generation per year.

Scouting and thresholds Inspect twigs during the dormant season for scale. Pay particular attention to weak plants. The crawlers are best observed during May to July with a 10X magnifying glass.

Management—chemical control

Most favorable period for control is in late summer or early fall after eggs have hatched.

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 344).

PNW Nursery IPM: Cottony camellia scale (http://oregonstate.edu/dept/nurspest/cottony%20camellia%20scale.htm)

Camellia *(Camellia)*—Root weevil

Otiorhynchus spp.

See:
Common Pests of Nursery Crops

Cherry, flowering *(Prunus)*—Aphid

Includes black cherry aphid *(Myzus cerasi)* and rusty plum aphid *(Hysteroneura setariae)*

See:
Common Pests of Nursery Crops

Pest description and crop damage Several aphid species attack cherry, including the rusty plum aphid and the black cherry aphid. The aphid feed initially on the shoot tips, which on young trees can cause stunting and malformation of the tips. On older trees, fruit set may be reduced in subsequent years if populations are high. Honeydew production can cause sooty mold problems on fruit.

Biology and life history The aphid overwinter as eggs in crevices and twigs. The eggs hatch near budbreak, and the nymphs feed on unopened buds and the underside of leaves. The leaves curl and protect the aphid as they feed. After two to three generations, winged forms are produced that migrate to summer hosts, which include weeds, ornamental plants, vegetables, or plants of the mustard family (in the case of black cherry aphid). After several more generations, the winged forms migrate back in the fall to the tree fruit to mate, and lay the overwintering eggs.

Scouting and thresholds Begin observing shoots prior to budbreak, as management is best done early and while the aphid are small.

Management—chemical control

See:

Chemical Control of Nursery Pests

Sprays are most effective if applied before leaves curl. It is important to cover foliage thoroughly, including lower leaf surfaces.

Cherry, flowering *(Prunus)*—Apple-and-thorn skeletonizer

Choreutis pariana

Pest description and crop damage Adult moth is reddish brown, with a wingspread less than 0.5 inch, and irregular light and dark bands on the wings. Larvae are 0.5 inch long, yellowish to greenish, with black spots and a yellow-brown head. Pupae are yellow to brown with a white silken cocoon. The larvae skeletonize and roll leaves. They feed on apple, crabapple, cherry, and hawthorn.

Biology and life history Adult moths overwinter in crevices in the tree. They lay eggs in small bunches on the undersides of leaves. The larvae emerge and feed on the underside of the leaves, then move to the top surface and feed there, often tying the sides together creating a "rolled" effect. There is often more than one caterpillar in the roll, and the leaf ends up skeletonized. After 3 to 4 weeks, they pupate in the rolled leaf. Adults emerge after about 2 weeks to start a new generation. There are at least two generations per year.

Scouting and thresholds Watch for signs of skeletonizing, which from a distance looks like the leaf tips have been burned.

Management—chemical control

See:

Chemical Control of Nursery Pests

Several applications may be needed during season. Do not apply to bloom.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 216).

PNW Nursery IPM: Apple-and-thorn skeletonizer (http://oregonstate.edu/dept/nurspest/apple_and_thorn_skeletonizer.htm)

Cherry, flowering *(Prunus)*—Cherry bark tortrix

Enarmonia formosana

Pest description and crop damage Cherry bark tortrix (CBT) occurs in Eurasia, Africa, and North America. CBT was first discovered in North America in 1989. By 1998, CBT was found in the Pacific Northwest as far south as Centralia, WA. CBT is slowly moving in surges southward and can be found as far south as Clackamas County. Eastern movement has yet to be seen due to the barrier of the Cascade Mountain range. Conditions in eastern Washington may not be favorable for CBT to survive except in protected riparian areas. CBT is a pest of most woody ornamental trees and shrubs in the family Rosaceae. CBT attacks *Prunus* (cherry, plum, and peach), *Malus* (apple, crabapple), *Pyrus* (pear), *Crataegus* (hawthorn), *Sorbus* (mountain ash), *Cydonia* (quince), *Pyracantha* (firethorn), and *Photinia*. The larvae are 0.33 to 0.4 inch long, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a yellowish-brown head. Larvae feed directly on the cambial tissues of the tree and may cause death of the tree in sufficient numbers. Otherwise, the feeding activity decreases the supply of nutrients to the tree and increases susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the exuding of gum-like resin, which often is mixed with fecal pellets and silk. The trunk and larger limbs of bearing fruit trees are affected, usually at pruning wounds.

Biology and life history CBT larvae overwinter under bark. During spring, they resume feeding and eventually pupate in a silken tube that protrudes beyond the bark surface where they were feeding. In Europe, pupation takes place from April until late August and lasts about 2 weeks. Adults fly from late April to September and are most active in the early morning; some may be attracted to lights at night. Eggs are laid on tree bark, in crevices, or under loose bark, primarily at wounds (mechanical or old infestations). Eggs are placed singly or in overlapping groups of two or three and hatch in 2 or 3 weeks. Hatching larvae penetrate the bark through openings (natural and mechanical wounds) and feed on the living tissue of the tree's bark. Graft unions of ornamental trees are preferred sites for attack. Larvae do not penetrate the hardwood of the tree. During feeding, CBT larvae construct a frass tube consisting of fecal pellets and webbing. The tubes are about 0.25 inch long and look soft, as if they are made out of sawdust. They probably will be around the base of the trunk or where a branch and trunk meet. The frass tube is the location for pupation once CBT has completed the larval stage.

Scouting and thresholds Frass tubes are an excellent indication of CBT infestations, and susceptible trees should be monitored regularly. Since other insects can cause similar damage, inspection of the larvae is required for confirmation.

Management—biological control

Although some wasp species parasitize the larvae, effective biological control does not occur at present. Avoid sprays which will disrupt whatever control does occur.

See:

Biological Control of Nursery Pests

Management—cultural control

Avoid unnecessary pruning cuts or injuries to the tree. Like most wood-boring insects, CBT is attracted to stressed trees. Keep trees as healthy as possible with appropriate watering, fertilizer applications, and pruning. Remove heavily infested branches or trees.

Management—chemical control

See:

Chemical Control of Nursery Pests

Control is best when insecticides are applied during the end of September to the beginning of October, when insect flights are finished, temperatures are moderate, and conditions are dry. Only spot-treat areas of the tree trunk, graft union, and large scaffold branches. Do not treat the tree canopy. Apply treatment to areas of frass tubes with low pressure until runoff. Little product is needed for good control.

Cherry, flowering *(Prunus)*—Pear sawfly

Caliroa cerasi

Pest description and crop damage Pear sawfly is a European insect now found in most areas of the U.S. It attacks both pear and cherry and also is found on mountain ash, hawthorn, and ornamental Prunus. The adult is a glossy black wasp, about 0.2 inch long. The larva initially resembles a small slug due to the olive green slime that covers the body, and the fact that the head is wider than the rest of the body. Mature larvae are 0.375 inch long and orange-yellow.

Larvae feed on the upper surface of leaves, skeletonizing them. Heavy feeding causes leaf drop, with reduction in vigor and yield, particularly on young trees.

Biology and life history Pear sawfly overwinters as a pupa in a cocoon 2 to 3 inches deep in the soil. Adults emerge over an extended period in late April–May. The adult female inserts eggs into leaf tissue, and eggs hatch in 10 to 15 days. Larvae immediately begin to feed on the upper surface of the leaf. After 3 to 4 weeks, they drop to the soil to pupate. Second generation adults emerge in July, and larvae from this generation feed in August and September. Most larvae from this generation drop to the ground to overwinter.

Scouting and thresholds Watch trees for the slug-like larvae in August and September when large populations can build up.

Management—cultural control

Individual larvae can be picked off, or they can be washed off with a strong stream of water.

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 130).

Cherry, flowering *(Prunus)*—Redhumped caterpillar

Schizura concinna

Pest description and crop damage Mature larvae are reddish or yellow and have several spines on each segment. The entire body is lined with white, dark reddish brown, and black lines. The head is red, and the fourth segment is humped. Has been a problem on cherry and other hosts east of the Cascades.

Management—biological control

See:

Biological Control of Nursery Pests

Management—cultural control

Individual larvae may be picked off, and entire colonies can be cut out.

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 156).

Cherry, flowering *(Prunus)*—San Jose scale

Quadraspidiotus perniciosus

See:

Common Pests of Nursery Crops

Pest description and crop damage San Jose scale was introduced to the U.S. on flowering peach in the 1870s, and is now a pest of all tree fruits and many ornamental and wild trees and shrubs throughout the U.S., particularly in hot, dry climates. San Jose scale can be differentiated from other scale insects by the scale (shell) that covers the adult females. The scale is hard, gray to black, and cone-shape. The scale has a tiny white knob in the center with a series of grooves or rings around it.

Biology and life history San Jose scale overwinters in an immature state under a black shell. In spring, the tiny winged males emerge and mate with wingless females. Females give birth to live young about a month later (no eggs are seen). The young scale (called “crawlers”) are very small, flattened, and yellow, and move around on bark and foliage before settling down to feed. Young scale also can be dispersed by wind, rain, irrigation, or by the movement of people and machinery. A few days later, they secrete a waxy coating over their body that protects them from pesticides. From this point, female scale do not move. Crawlers appear during June and July and again in August to September. There are two generations per year.

Scouting and thresholds In cherry orchards, leaves of infested trees do not drop in fall, making detection straightforward. Inspect twigs during the dormant season for scale. Pay particular attention to weak plants. Observe the young bark for purplish-red halos, which indicate infestation. The crawlers are best observed during June and July with a 10X magnifying glass. Monitor crawlers by wrapping a piece of black sticky tape around an infested branch with the sticky side out.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 386).

Cherry, flowering *(Prunus)*—Shothole borer

Scolytus rugulosus

Pest description and crop damage Small black beetles with antennae, legs, and tips of elytra cinnamon red. Normally attack sickly trees by boring into limbs. Also bore into buds of healthy trees.

Scouting and thresholds Entry holes and borer damage greatly affect marketability, action thresholds are very low. Prevention is key.

Management—cultural control

Burn prunings and keep trees vigorous. Borer attack usually indicates trees are unhealthy.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply materials to the trunk and larger limbs. Avoid contacting foliage. Apply generally in late spring or when adults are active.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 250).

Cherry, flowering *(Prunus)*—Spider mite

Includes
European red mite *(Panonychus ulmi)*
Twospotted spider mite *(Tetranychus urticae)*

See:
Common Pests of Nursery Crops

Pest description and crop damage Several species of mites can cause damage in ornamental cherry. Principal mite pests of cherries include the European red mite and the twospotted spider mite. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Female European red mites are round with red bodies; males are yellowish-red. Twospotted mites are oval and yellowish-brown or green with distinctive black spots on the body. Mites damage fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

Biology and life history Red mite overwinters as eggs on smaller branches and fruit spurs. They hatch at pink stage and commence feeding. There are six to seven generations per year.

Management—chemical control

Horticultural oils are most effective against European red mite, and during the egg stage of the mite life cycle.

Chestnut *(Castanea)*—Shothole borer

Xyleborus dispar

Pest description and crop damage An ambrosia-type bark beetle that is small and generally black or dark brown. This is a European beetle first found in Washington in Clark County in 1901. There are up to two generations per year. They overwinter as adults in the host trees, often with their dark rear ends visible in their galleries. Adults bore into sapwood. Males are smaller than females, and flightless. The females initially move to new, generally stressed trees, then emit an aggregation pheromone that attracts more beetles. Arriving beetles land on infested and nearby trees. New plantings are especially susceptible to attack.

Scouting and thresholds Monitor flights of beetles with ethanol-baited funnel traps from February through the end of summer. Look for fresh sawdust and sap on trees to detect injury. Yellow magnolias are very susceptible and can act as an indicator plant for beetle activity. Even one hole in a tree reduces its quality and most growers treat when beetle flights first occur on warm summer days in late winter or spring.

Management—cultural control

Keep trees vigorous. Rogue and destroy infested trees immediately.

Management—chemical control

See:
Chemical Control of Nursery Pests

Control options are poorly understood at this time. Early spring applications are required. Apply materials to the trunk and lower limbs. Avoid contacting foliage.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 250).

PNW Nursery IPM: European shothole borer (http://oregonstate.edu/dept/nurspest/xyleborus_dispar.htm)

Cotoneaster *(Cotoneaster)*—Aphid

Several species

See:
Common Pests of Nursery Crops

Cotoneaster *(Cotoneaster)*—Cotoneaster webworm

Cremona cotoneastri

Pest description and crop damage The cotoneaster webworm is a dark brown caterpillar, 0.25 to 0.5 inch long. It typically ties clumps of leaves together with webbing and feeds within the nests, skeletonizing leaves. The webworm is primarily a problem on Cotoneaster horizontalis (rock cotoneaster).

Biology and life history The caterpillars feed during the summer and fall, overwintering in nests on the plant and pupating in the spring. The dark gray, night-flying adult moth emerges in the spring to lay eggs.

Management—biological control

See:
Biological Control of Nursery Pests

Management—cultural control

Hand-pick and destroy larvae; prune out nests.

Management—chemical control

See:
Chemical Control of Nursery Pests

Cotoneaster *(Cotoneaster)*—Spider mite

Several species, including *Tetranychus* spp.

See:
Common Pests of Nursery Crops

Cottonwood *(Populus)*—Aphid

See:
Common Pests of Nursery Crops

Cottonwood *(Populus)*—Satin moth

Leucoma salicis

Pest description and crop damage The adult moth is satiny white. Larvae are approximately 2 inches long when grown and reddish brown with white patches on top and tufts of hairs along the sides. They can defoliate cottonwood, poplar, and willow seriously. They occasionally attack oak and aspen.

Biology and life history The insect overwinters as a larva in a small silken cocoon attached to the trunk or branch of the host tree. The larva becomes active and feeds after leaves have fully formed in the spring. After pupation, the adult moth emerges in midsummer. The adult moths are attracted to lights. The females lay eggs in masses on host plants, often on the leaves but also on bark. After hatching, the young larvae feed until fall, then hibernate. There is one generation per year.

Scouting and thresholds Watch for signs of skeletonizing.

Management—biological control

See:
Biological Control of Nursery Pests

Management—cultural control

Larvae and pupae may be removed from affected leaves. Remove heavily infested twigs.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply when larvae are present and feeding.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 158).

Crabapple *(Malus)*—Leafroller and leaftier

Fruittree leafroller *(Archips argyrospila)*
Obliquebanded leafroller *(Choristoneura rosaceana)*

Pest description and crop damage There are several species of leafroller and leaftier pests of Malus. These are larvae of several moth species, which use native plants as hosts as well as fruit trees. They all cause similar damage to the trees but differ in their appearance and, more importantly, in their life cycle. The principal leafroller pests can be divided into single-generation moths, such as the fruittree leafroller and the European leafroller; and two-generation moths, such as the obliquebanded leafroller and threelined leafroller. Adults of these species are variable in color, ranging from fawn-colored to dark brown. There are distinctive bands or mottling on the wings. Wing spans range from 0.5 to 1 inch. The larvae of these species are all green caterpillars with a light brown to black head, depending on species. Leaftiers are similar in appearance, although larvae are up to 0.5 inch long, dirty white, with a brownish head.

As the name leafroller or leaftier implies, the larvae roll and tie leaves together for shelter and feeding. Leafroller larvae thrash about violently when disturbed, and may drop from the leaf suspended by a silken thread. The larvae web leaves and flowers together and feed on and tunnel into the unripe and ripe fruit. Feeding on growing points on young plants can promote undesirable branching. Larvae also feed on the surface of the fruit, causing deep, russetted scars.

Biology and life history The single-generation leafrollers overwinter as egg masses on twigs and branches. Eggs hatch in spring as buds are opening, and hatch is completed by petal fall. The larvae feed for 4 to 6 weeks, then pupate in the rolled leaves and emerge as moths in early summer. The overwintering eggs are laid in July. Two-generation leafrollers overwinter as immature larvae under the bark on scaffold branches of a variety of host plants. Larvae may feed during warm periods in winter, but become active in spring with onset of new growth. They feed for several weeks, then pupate in rolled leaves. Adult moths emerge in late April–May. These lay eggs for the next generation. The next generation hatches in early summer and does the most damage.

Leaftiers overwinter in silken cases as young larvae on bark of trees and other rough surfaces. In spring, the larvae spin silken threads and are carried by wind to host plants. The larvae web the leaves and flowers together beginning in late April, then feed on the developing fruit. The moths appear in June and July and lay eggs. There is one generation per year.

Scouting and thresholds Observe early spring growth for rolled leaves and feeding damage on new growth.

Management—biological control

See:
Biological Control of Nursery Pests

Very low temperatures in winter significantly reduce overwintering populations of larvae. Spiders and parasitic wasps, as well as predators like the brown lacewing, greatly reduce leafroller populations throughout the year.

Management—cultural control

Hand-pick rolled leaves containing larvae or pupae. Removal of overwintering sites, such as rolled leaves on the ground or plastered to trees, can reduce next year's population.

Management—chemical control

See:
Chemical Control of Nursery Pests

Crabapple *(Malus)*—San Jose scale

Quadraspidiotus perniciosus

See:
Common Pests of Nursery Crops

Daffodil *(Narcissus)*—Bulb mite

Rhizoglyphus echinopus

Pest description and crop damage Mature bulb mites vary from about 0.02 to 0.03 inch (0.5 to 0.9 mm) long and have four pairs of legs. Their bodies are shiny, white, somewhat transparent, and smooth with reddish brown appendages. They are usually found in colonies. Their oval shape and sluggish behavior can deceive the human eye into identifying them as eggs. They avoid the light, and hide under damaged or diseased tissue. Bulbs infested with bulb mites may rot and fail to produce new growth, or new growth may be off-color, stunted, and distorted. Although the bulb mite is not considered a primary pest of bulbs, it is often responsible for serious losses; the slightest injury to a bulb will allow bulb mites to enter and become established. Once the mites are inside the bulb, they rapidly turn the bulbs into rotten pulp. Injured or bruised bulbs are the most susceptible to damage. Not only do mites destroy bulb tissue, but they also carry fungi and bacteria which often spur additional damage. Bulb mites also heavily affect hyacinths and lilies.

Biology and life history Bulb mites rarely are noticed as isolated individuals, but rather as large colonies. All stages of the mite can be found throughout the year.

Management—cultural control

It is very important to avoid rough handling of bulbs to prevent injury that might afford an entry point for fungi and bulb mites. Bulb mites cannot withstand drought, and dry bulbs in storage usually are not attacked (unless mites are already deep inside tissue).

Management—chemical control

No chemical controls listed.

Daffodil *(Narcissus)*—Narcissus bulb fly

Merodon equestis

Pest description and crop damage The adult narcissus bulb fly is about 0.5 inch long and closely resembles a small bumblebee. The larva is yellowish-white and 0.75 inch long. The maggots burrow into the bulbs near the basal plate and feed inside the bulbs, destroying bulb scale and flower parts. Infested bulbs may develop a few, grassy-looking leaves if the bulb is not too badly damaged. Severely damaged bulbs are soft, brown, and decayed.

Biology and life history The female lays eggs near the bulbs during May or early June. The eggs hatch into grubs that move down into the soil and burrow into the base of the bulb to feed there, reducing the bulb's center to a rotten mass. In the process, the embryonic flowers that would have unfolded the following spring are destroyed. After feeding, larvae leave the bulb to pupate in the soil. In the spring, the grubs emerge as adult flies to mate and lay eggs.

Management—cultural control

Narcissus fly can be evaded by deep planting (10 inches). Plant in open areas exposed to wind. Bulb flies are usually less of a problem in such sites. Covering foliage of plants with a row cover after bloom prevents egg-laying. Plant only firm, healthy bulbs. Soft bulbs may be infested from the previous season. Destroy any soft bulbs to prevent emergence of adult bulb flies.

Management—chemical control

No chemical controls listed.

For more information

The Narcissus Bulb Fly (http://whatcom.wsu.edu/ag/homehort/pest/bulbflies.htm)

Dahlia *(Dahlia)*—Western spotted cucumber beetle

Diabrotica undecimpunctata

Pest description and crop damage The adult western spotted cucumber beetle is yellowish green, 0.25 inch long, and has 11 black spots on its wing covers. Mature larvae are white, except for the head and last abdominal segment, which are brown. They are about 0.625 inch long. The larvae appear to have "two heads." The adult beetles eat small holes in the leaves. Larvae feed on roots and bore into the base of stems, killing small plants and reducing root mass in mature plants.

Biology and life history Cucumber beetles overwinter as fertilized females and are active beginning in early spring. Adults lay eggs at the base of plants. Eggs hatch in 7 to 10 days, and larvae feed in roots for about 3 weeks before pupating in the soil. Adults emerge 2 weeks later and feed on pollen, foliage, flowers, and pods. There are two generations per year.

Management—biological control

nematodes—Soil must be warmer than 53°F (larvae only).

Management—cultural control

In most years, beetle populations diminish after egg laying and before the emergence of the summer population. Planting can be delayed until after the beetles have dispersed and deposited most of their eggs. Individual beetles can be picked off.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

PNW Nursery IPM: Western spotted cucumber beetle (http://oregonstate.edu/dept/nurspest/western_spotted_cucumber_beetle.htm)

Daphne *(Daphne)*—Lecanium scale

Lecanium spp.

See:
Common Pests of Nursery Crops

Dogwood *(Cornus)*—Brown soft scale

Coccus hesperidum

See:
Common Pests of Nursery Crops

Pest description and crop damage Flat and brown. Small, about 0.19 inch long. Sooty mold indicates presence in abundance.

Dogwood *(Cornus)*—Oystershell scale

Lepidosaphes ulmi

See:

Birch *(Betula)*—Oystershell scale

Common Pests of Nursery Crops

Douglas-fir *(Pseudotsuga)*—Aphid

Cinara spp.

See:

Common Pests of Nursery Crops

Pest description and crop damage The aphid that infest Douglas-fir are large insects, up to 0.2 inch long. They may range in color from gray to brownish to dark. The aphid establish large colonies on the twigs but rarely are found feeding on needles. Feeding and honeydew production can cause sooty mold problems on foliage and nearby surfaces.

Biology and life history Most species of aphid have similar life cycles. The aphid overwinter as eggs on the host tree. Hatch occurs in the spring, and there may be several wingless generations during the growing season. In summer and fall, aphid may produce winged females and, later, winged males. They mate and produce eggs for overwintering, especially in colder climates.

Management—chemical control

See:

Chemical Control of Nursery Pests

See "Douglas-fir" in:

Christmas Tree Plantation Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 82-84).

Douglas-fir *(Pseudotsuga)*—Coneworm

Dioryctria spp.

Pest description and crop damage The adult coneworm is a mottled gray moth. The coneworms are small and cream-color or light brown with a darker head. Coneworms attack Douglas-fir by boring into shoot tips or stems, especially around wounds, and feeding on the soft bark tissues. The portion of the branch beyond the injured point may die back. Coneworms also may bore into green cones, feed on the soft bark of young growth, or feed inside the bark on the trunk cambium. Coneworms also attack pines, hemlocks, true firs, and spruce.

Management—cultural control

Plant nonsusceptible conifers where this pest is a problem. Remove and destroy infested cones and twigs when possible.

Management—chemical control

See:

Chemical Control of Nursery Pests

See "Douglas-fir" in:

Christmas Tree Plantation Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 48-50).

Douglas-fir *(Pseudotsuga)*—Cooley spruce gall adelgid

Adelges cooleyi

Pest description and crop damage This aphid-like insect feeds on newly growing needles. Adelgids appear as woolly or cottony tufts on the undersides of needles, with heavily infested trees appearing "frosted" or flocked. Small purplish insects are found underneath the cottony tufts.

Adelgid feeding can cause needles to become distorted or bent and yellowed. Infested needles turn brown and sometimes drop prematurely. This pest is a serious concern in Christmas tree plantations, but is less important in the landscape. Cooley spruce gall adelgids also infest spruces, but cause distinctive galls on spruce that are not seen on Douglas-fir.

Management—cultural control

Plant Douglas-fir and spruce as far apart as possible.

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply to control crawlers after eggs hatch, usually at the time when new tip growth is expanding.

See "Douglas-fir" in:

Christmas Tree Plantation Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 76).

Douglas-fir *(Pseudotsuga)*—Douglas-fir needle midge

Contarinia spp.

Pest description and crop damage The adult Douglas-fir needle midge is a small fly. Three different midges infest Douglas-fir: one species feeds near the needle base, one feeds near the tip of the needle, and the third feeds near the middle. The tiny white larvae of the Douglas-fir needle midge mine the inside of needles, which become yellowed and distorted. Infested needles often have a sharp bend at the injury site. Damaged needles often drop from the tree, and heavy midge infestations can cause severe defoliation.

Biology and life history The midges pupate in the ground, with the adults emerging around budbreak in the spring. They lay eggs on the new growth, and the newly hatched larvae mine the needles and feed through the summer. At the end of the summer, they drop to the ground to pupate. There is one generation per year.

Sampling and thresholds Time applications, based on adult needle midge trap catch, to coincide with adult emergence.

Management—cultural control

Prune out heavily infested twigs and branches.

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 44).

Ornamentals Northwest Archives: Douglas-fir needle midge (http://oregonstate.edu/dept/nurserystartup/onnpdf/onn060108.pdf)

Douglas-fir *(Pseudotsuga)*—Douglas-fir tussock moth

Orgyia pseudotsugata

Pest description and crop damage The adult moth flies during the day and is brown to gray, about 1 inch across. Mature larvae are about an inch long, hairy, gray or light brown, with black heads. They are distinguished by three long tufts of black hairs on their body (two in front, one in back) and lighter tufts along their back. The hairs from tussock moth caterpillars break off easily and may cause skin or respiratory irritation. The larvae start at branch tips at the top of the tree and work down, feeding mainly on the new foliage and causing severe defoliation. They may be found under webbing on the branches. The preferred hosts are Douglas-fir, grand fir, and white fir, although it also may be a problem on spruce, pine, and larch. They feed mainly on forest trees and are infrequent pests in the landscape.

Biology and life history The insect overwinters as eggs. The larvae emerge in the spring as buds break and begin feeding on the new growth. The insect pupates in cocoons on the host plant, and adults emerge in summer. The flightless females deposit eggs near the cocoon from which they emerged, usually on the trunk and underside of large branches. There is one generation per year.

Management—biological control

A variety of predators and parasites keep this pest under control most of the time. Severe tussock moth outbreaks are very sporadic and last usually about three years before subsiding.

See:

Biological Control of Nursery Pests

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 34).

Douglas-fir *(Pseudotsuga)*—Douglas-fir twig weevil

Cylindrocopturus furnissi

Pest description and crop damage The Douglas-fir twig weevil is a small, wingless, grayish-black beetle with white markings and sometimes pinkish spots. The larvae mine under the bark or inside twigs. Infested twigs and small branches often turn a reddish-brown and die back. Small, stressed trees are especially susceptible to attack by the weevils, particularly in dry years.

Biology and life history The weevil overwinters as a larva or adult. The adult lays eggs in twigs in the summer. The larvae feed by mining just beneath the bark and pupate at the ends of the galleries the following spring. There is one complete generation per year.

Management—cultural control

Pick off adults if seen. Remove and burn infested twigs. Keep trees healthy with proper cultural practices, as healthy trees can better withstand insect damage.

Management—chemical control

No chemical controls listed.

See "Douglas-fir" in:
Christmas Tree Plantation Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 60).

Douglas-fir *(Pseudotsuga)*—Sequoia pitch moth

Synanthedon sequoiae

Pest description and crop damage The adult moth is clear-winged with yellow and black markings resembling yellow-jacket wasps. The larvae are about 1 inch long, yellowish, with a reddish brown head.

The larvae of the sequoia pitch moth feed by boring into branches or trunks. At the point where the larva enters the wood, small to large masses of white to pinkish pitch accumulate. The larva feeds locally underneath the pitch mass. This pest causes mainly aesthetic damage because of the pitch masses. Incidentally, they do not attack Sequoia, the coast redwood.

Biology and life history Eggs are laid on the bark of host trees. The larvae bore into the inner bark and establish a feeding site. The feeding site can be distinguished easily by the large accumulation of pitch and frass on the exterior of the bark. Pupation takes place within this mass, and the adult moths fly in summer. About half the population completes its life cycle in 1 year; the other half requires 2 years.

Sampling and thresholds A pheromone trap is available to time adult activity.

Management—cultural control

Healthy trees are not commonly attacked. Infestations often are associated with pruning wounds or mechanical damage to the tree. Trees which are wounded in the spring and summer when adult moths are flying are far more likely to be attacked than those pruned or injured in the fall and winter. The moths also may be attracted to trees undergoing stresses associated with drought or saturated soil. Remove pitch masses by hand.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply materials to the trunk and lower limbs. Avoid contacting foliage.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 72).

PNW Nursery IPM: Sequoia pitch moth (http://oregonstate.edu/dept/nurspest/sequoiapitchmoth.htm)

Douglas-fir *(Pseudotsuga)*—Silverspotted tiger moth

Halisidota argentata

Pest description and crop damage Adult moths are brownish or tan with distinct silver-white spots on the wings. The caterpillars can reach 1.5 inches in length and are mostly reddish-brown with some blue-black or yellowish hairs.

The caterpillars of the silverspotted tiger moth feed on the needles, often "tenting" branches with dirty-looking webs. Feeding occurs through fall and winter, with webs becoming more noticeable by spring. Minor infestations cause little harm to trees. Douglas-fir is the preferred host, but pine, arborvitae, spruce, and true firs also are attacked.

Biology and life history Larvae hibernate in dense clusters on twigs and become active on warm winter days. Larvae mature in June.

Management—cultural control

Prune out and destroy tents with caterpillars. Caterpillar hairs can cause skin irritation if they are handled without gloves.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 34).

Douglas-fir *(Pseudotsuga)*—Spruce spider mite

Oligonychus ununguis

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

See:
Arborvitae *(Thuja)*—Spider mite
Christmas Tree Plantation Pests

Elm *(Ulmus)*—Aphid

Includes wooly elm aphid *(Eriosoma americanum)*

See:
Common Pests of Nursery Crops

Elm *(Ulmus)*—Elm leaf beetle

Pyrrhalta luteola

Pest description and crop damage Adult elm leaf beetles are approximately 0.25 inch long and yellow to greenish with two dark stripes. Older adults are darker. The 0.25 inch larvae are greenish or yellow with black lateral stripes and spots. Elm leaf beetles feed on the leaves both as larvae and as adults. They skeletonize leaves, feeding on the underside and eating all parts except the veins and upper cuticle, which turn brown. Adult feeding causes small holes in the leaves. Severe infestations may result in severe premature leaf loss. Trees may releaf in late summer. Repeated infestations may weaken or kill trees. Weakened trees are also more susceptible to attack by elm bark beetles, which can carry the Dutch elm disease fungus.

Biology and life history The insect overwinters as adults in protected places both indoors and outdoors. In spring, the adults fly to trees as the leaves are expanding and chew circular holes in them. Eggs are laid in clusters on the leaves, and the larvae appear in late spring (typically May–June). The larvae emerge and feed on the undersides of leaves. They feed for a period, then migrate to the lower parts of the tree and pupate on the ground or in crevices near the base of the tree. The second generation emerges 1 or 2 weeks later. There are two generations per year.

Management—biological control

Bacillus thuringiensis tenebrionus (Btt) (Novodor)

Management—cultural control

Plant resistant cultivars of American elm *(Ulmus americana)*. These include ‘Dynasty,’ ‘Princeton,’ ‘Prospector,’ ‘Frontier,’ and ‘Pathfinder.’ (Note: Many American elm cultivars are highly susceptible to Dutch elm disease). Other elms reported to be somewhat resistant to elm leaf beetle feeding include Chinese elm *(U. parvifolia)* and the elm-like zelkovas (*Zelkova* spp.).

Provide proper culture to maintain plant health. Healthy plants are more tolerant of insect damage. Prune dead and dying branches in late fall or winter.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply when first larval damage appears. Do not use acephate on American elm.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 222).

Elm *(Ulmus)*—Elm leafminer

Fenusa ulmi

Pest description and crop damage Small legless sawfly larva feed between the layers of leaf epidermis, resulting in large brown blotches. The elm leafminer, Fenusa ulmi, has been in the Northwest for a few years but has been noticeable in its expansion to new areas in Washington and Oregon recently. The sawfly attacks Scotch and Camperdown elms, *Ulmus glabra*), and Engish elm, *U. procera*.

Biology and life history The adult sawflies emerge coinciding with the breaking of the leaf buds of most elms, although after leaf expansion of American and European white elms (Scannell, 2000). The timing of emergence ranged from mid-March through mid-April depending on temperatures during the course of several years of study. The adults are all female and begin to lay eggs immediately after emergence. The eggs are usually laid near leaf veins initially but later oviposition is without regard to location of the veins. There are five instars of the larvae. The larvae were found about 10 days after the first emergence of the adult sawflies. The larvae eventually drop to the ground where they are reported to pupate through the summer, fall, and winter. There is one generation per year.

Management—cultural control

Remove infested leaves and destroy. American elm may have some resistance.

Management—chemical control

See:

Chemical Control of Nursery Pests

Spray when blotch mines first appear or before leaves fall. Do not use acephate on American elm.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 186).

PNW Nursery IPM: Elm leafminer (http://oregonstate.edu/dept/nurspest/elm_leafminer.htm)

Elm *(Ulmus)*—European elm scale

Gossyparia spuria

The European elm scale is a reddish-brown to purplish scale surrounded by a conspicuous fringe of white, waxy material. They sometimes resemble mealybugs. The mature females are about 0.125 inch in diameter. The crawlers emerge in late spring and summer and are yellowish to dark brown. The scale feed on twigs and branches as well as leaves. Feeding scale produce honeydew, a sweet, sticky material which attracts honeydew-feeding ants and may become covered with a growth of black sooty mold. Infested trees may show yellowing leaves and early leaf drop, followed by death of twigs and branches. Severe infestations may cause extensive damage.

Biology and life history The scale overwinter as immature crawlers in bark crevices of small branches and branch crotches. In spring, the females lay eggs, and crawlers are active by June. They move to the undersides of leaves to feed, remaining there all summer. Often, the scale drop to the ground with the normal leaf-fall and are killed. There is one generation per year.

Management—cultural control

Asiatic elms such as Chinese elm *(U. parvifolia)* apparently are not infested. Siberian elm *(U. pumila)* is also resistant but is a poor shade tree. Provide proper culture to maintain plant health. Healthy trees are more able to tolerate scale infestations. Prune and destroy twigs to help control isolated infestations, when practical.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 368).

Elm *(Ulmus)*—Spiny elm caterpillar (mourning cloak butterfly)

Nymphalis antiopa

Pest description and crop damage The spiny elm caterpillar is the larval stage of the mourningcloak butterfly. The adult is approximately 2.5 inches across, with purplish-brown to black wings bordered by a creamy yellow stripe and a row of blue spots. The larvae are purplish-black with white specks and have a row of orange to red spots along the back. They have brownish prolegs and are clothed with long, forked spines. The caterpillars often feed in large groups and eat all the leaves on a branch before moving. Their feeding results in raggedly chewed leaves. Spiny elm caterpillars also feed on willow and poplar trees. They are not a serious pest.

Biology and life history The insect overwinters in protected places as an adult butterfly, and is found flying early in the spring after budbreak. The females lay eggs in masses on twigs, and the larvae hatch to feed in large groups. After feeding, the larva pupates by suspending itself from the leaf in a chrysalis. The second generation, if there is one, emerges in August.

Management—biological control

There are several wasp parasites of the larvae, and some birds also eat the larvae.

Management—cultural control

Hand-pick larvae and remove heavily infested branches.

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 152).

Euonymus *(Euonymus)*—Euonymus scale

Unaspis euonymi

See:

Common Pests of Nursery Crops

Pest description and crop damage Euonymus scale females are dark, 0.0625 inch long, and mussel-shape. The males are narrow, elongative, and white. Crawlers are orange. Euonymus scale are found on both leaves and stems. Infested leaves develop yellow to white spots from scale feeding, and in severe cases significant defoliation can occur. Euonymus scale infests a wide range of ornamental genera that include *Camellia*, *Buxus*, *Daphne*, *Hedera*, *Ilex, Jasminum, Ligustrum, Lonicera, Pachysandra,* and *Prunus*.

Biology and life history The scale overwinters as fertilized females. Crawlers emerge in the spring from beneath the shells of the overwintering females. There may be two to three generations per year.

Management—biological control

See:

Biological Control of Nursery Pests

Management—cultural control

Evergreen euonymus *(E. japonica)* is extremely susceptible to scale infestations, as is spindle tree *(E. europaeus)*. Plant resistant species. *Euonymus alata* (especially 'Compacta') and *E. fortunei* 'Acutus' are seldom infested. Several other species, including *E. kiautschovicus*, will tolerate scale feeding. Hand-wipe to help control small infestations, when practical. Prune out heavily infested branches. Apply Tanglefoot, "stickem," or a similar adhesive around infestations of adult scale to catch the crawler stage. As with aphids, avoid excessive nitrogen fertilizer, as this favors population increase.

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply in May and again in June or July.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 388).

Fir *(Abies)*—Balsam twig aphid

Mindarus abietinus

See:

Common Pests of Nursery Crops

Pest description and crop damage Balsam twig aphids feed on needles and buds of firs. Three distinct forms of the balsam twig aphid occur. Aphids may be (1) small and yellow-green, (2) large and bluish-gray, or (3) have woolly white secretions which make them appear powdery. The aphids mat needles together and cause new growth to be deformed and stunted. Some needles are killed and drop from the tree, leaving rough twigs. The insects excrete a large amount of sticky honeydew which may be covered with a black growth of sooty mold. Healthy trees will tolerate moderate infestations easily.

Biology and life history Unlike other aphid species, there is one generation per year. The aphids overwinter as eggs on host trees. The eggs hatch and the nymphs molt into "stem mothers," which are large and blue-gray, and capable of giving birth to live young. These aphids are covered with a white waxy coating and feed on new flushes of growth, doing most of the damage. They mature into the final, winged form, the females of which lay the overwintering eggs in bark crevices.

Management—chemical control

See:

Chemical Control of Nursery Pests

Spray in spring. A second application may be needed in June. It is important to cover foliage thoroughly, including lower leaf surfaces.

See "True fir" in:

Christmas Tree Plantation Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 80).

Fir *(Abies)*—Balsam woolly adelgid

Adelges piceae

Pest description and crop damage The balsam woolly adelgid feeds on the stems of true firs. White or grayish cottony masses, inside which are the purplish-black insects, can be found on the twigs, branches, or trunk. Heavy adelgid infestations may cover the entire trunk. The feeding insects cause the tree to form swollen, knobs areas at nodes and tips of infested branches. Adelgid infestations weaken trees, cause foliage to become sparse, and can kill trees. This is a serious pest in the forest and the landscape on balsam, grand, subalpine, Pacific silver, and Fraser firs. Balsam fir and subalpine fir are particularly susceptible.

Biology and life history The entire population consists of female insects, which are wingless. They are immobile except for a crawler stage. Eggs are laid on the bark, from which the crawlers emerge. Crawlers can be carried from tree to tree by wind. There are two to four generations per year.

Management—chemical control

See:

Chemical Control of Nursery Pests

Begin monitoring in late April to early May when crawlers can be seen. Spray in early spring at or near budbreak. Thorough coverage is necessary. Difficult to control with anything other than high-pressure spray equipment.

See "True fir" in:

Christmas Tree Plantation Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 74).

Fir *(Abies)*—Bow-legged fir aphid

Cinara curvipes

See:

Common Pests of Nursery Crops

Pest description and crop damage About 200 species of Cinara attack pine, spruce, fir and cypress throughout the United States. Many of these are large (up to 0.2 inch), dark brown to black, and almost spider-like. Aphids congregate in large colonies to feed on the bark of twigs and even the main stem of small trees. The feeding causes yellowing of foliage, leaf drop and can cause limbs to die. Serious damage can be done to young trees.

Biology and life history These aphids overwinter as eggs on twigs or branches. Adults and nymphs begin feeding on stems in the spring.

Management—biological control

See:

Biological Control of Nursery Pests

Management—cultural control

Hand-wipe to remove minor infestations when possible. Hose infested trees with a strong stream of water to wash off these insects.

Management—chemical control

See:

Chemical Control of Nursery Pests

It is important to cover foliage thoroughly, including lower leaf surfaces.

See "True fir" in:

Christmas Tree Plantation Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 82-84).

Fir *(Abies)*—Coneworm

Dioryctria spp.

Pest description and crop damage The adult coneworm is a mottled gray moth. The coneworms are small and cream-color or light brown with a darker head. Coneworms attack true firs by boring into shoot tips or stems, especially around wounds, and feeding on the soft bark tissues. The portion of the branch beyond the injured point may die back. Coneworms also may bore into green cones, feed on the soft bark of young growth, or feed inside the bark on the trunk cambium. Coneworms also attack pines, hemlocks, Douglas-fir, and spruce.

Management—cultural control

Plant non-susceptible conifers where this pest is a problem. Remove and destroy infested cones and twigs when possible.

Management—chemical control

See:

Chemical Control of Nursery Pests

See also "True fir" in:

Christmas Tree Plantation Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 48-50).

Fir *(Abies)*—Spruce budworm

Pest description and crop damage Adult moths are mottled orange-brown and have a wingspan up to 1 inch. The larvae are typically green to brown with a darker head and grow to approximately 1 inch in length. These larvae feed on the buds and foliage and may tie shoot tips together with webbing to make a nest.

Spruce budworms are mainly pests of balsam and subalpine firs. They also attack spruce and Douglas-fir. Although a significant problem in forestry situations, this insect is an infrequent pest in the landscape.

Biology and life cycle The larvae overwinter in small silken cocoons which are hard to locate. The following spring, larvae emerge and spin long silken threads that aid in their dispersal. Eggs are light green and laid in shingle-like masses on the underside of needles in mid-July.

Management—biological control

See:

Biological Control of Nursery Pests

Management—cultural control

Hand-pick larvae when found.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply in May and again in June.

See also "True firs" in:
Christmas Tree Plantation Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 28).

Fir *(Abies)*—Spruce spider mite

Oligonychus ununguis

See:
Common Pests of Nursery Crops

Fuchsia *(Fuchsia)*—Fuchsia gall mite

Aculops fuchsiae

Pest description and crop damage Tiny mites (Eriophyidae) infest growing tips, young leaves, and blooms and cause distorted, twisted, and blistered growth. They are primarily in coastal areas. They are spread by wind and by movement of infested stock.

Management—biological controls

Predatory mites are important biological control agents.

Management—cultural control

Fuchsia species and cultivars differ widely in susceptibility to these mites. For resistant and susceptible clones, see p. 486 in W.T. Johnson and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press.

Management—chemical control

See:
Chemical Control of Nursery Pests

Golden chain *(Laburnum)*—Aphid

Several species

See:
Common Pests of Nursery Crops

Golden chain *(Laburnum)*—Leafminer

Leucoptera (probably Iaburnella)

See:
Common Pests of Nursery Crops

Pest description and crop damage Mines leaves in blotches and can defoliate trees.—biological control

May be under control by natural parasites.

Management—chemical control

See:
Chemical Control of Nursery Pests

Use as foliar spray as soon as mines are seen.

Golden chain *(Laburnum)*—Spider mite

Tetranychus spp.

See:
Common Pests of Nursery Crops

Hawthorn *(Crataegus)*—Apple-and-thorn skeletonizer

Choreutis pariana

See:
Cherry, flowering *(Prunus)*—Apple-and-thorn skeletonizer

Hawthorn *(Crataegus)*—Hawthorn aphid

Anuraphis craetaegifoliae

See:
Common Pests of Nursery Crops

Pest description and crop damage Pinkish green to yellowish green aphid; causes leaves to curl tightly.

Hawthorn *(Crataegus)*—Leafroller

Several species

Pest description and crop damage Several species of leafroller are pests of hawthorn. These are larvae of moths which use native plants as hosts as well as fruit trees. They all cause similar damage to the trees but differ in their appearance and, more importantly, in their life cycle. The principal leafroller pests of fruit trees can be divided into single-generation moths, such as the fruittree leafroller and the European leafroller, and two-generation moths, such as the obliquebanded leafroller and threelined leafroller. Adults of these species range from fawn-color to dark brown. Distinctive bands or mottling are on the wings. Wingspans range from 0.5 to 1 inch. The larvae of these species are all green caterpillars with a head that will be light brown to black depending on species.

As the name leafroller implies, the larvae roll and tie leaves together for shelter and feeding. Leafroller larvae thrash about violently when disturbed, and may drop from the leaf suspended by a silken thread. The larvae web leaves and flowers together and feed on and tunnel into the unripe and ripe fruit. Feeding on growing points on young plants can promote undesirable branching. Larvae also feed on the surface of the fruit, causing deep, russeted scars.

Biology and life history The single-generation leafrollers overwinter as egg masses on twigs and branches. Eggs hatch in spring as buds are opening, and hatch is completed by petal fall. The larvae feed for 4 to 6 weeks, then pupate in the rolled leaves and emerge as moths in early summer. The overwintering eggs are laid in July.

Two-generation leafrollers overwinter as immature larvae under the bark on scaffold branches of a variety of host plants. Larvae may feed during warm periods in winter, but become active in spring with onset of new growth. They feed for several weeks, then pupate in rolled leaves. Adult moths emerge in late April–May. These lay eggs for the next generation. The next generation hatches in early summer and does the most damage.

Scouting and thresholds Observe early spring growth for rolled leaves and feeding damage on new growth.

Management—chemical control

Apply when first rollers appear.

See:
Chemical Control of Nursery Pests

Hawthorn *(Crataegus)*—Pear sawfly

Caliroa cerasi

See:
Cherry, flowering *(Prunus)*—Pear sawfly

Hawthorn *(Crataegus)*—Scale insect

Several species

See:
Common Pests of Nursery Crops

Hawthorn *(Crataegus)*—Spider mite

Tetranychus spp.

See:
Common Pests of Nursery Crops

Hemlock *(Tsuga)*—Coneworm

Dioryctria spp.

Pest description and crop damage The adult coneworm is a mottled gray moth. The coneworms are small and cream-color or light brown with a darker head. Coneworms attack true firs by boring into shoot tips or stems, especially around wounds, and feeding on the soft bark tissues. The portion of the branch beyond the injured point may die back. Coneworms also may bore into green cones, feed on the soft bark of young growth, or feed inside the bark on the trunk cambium. Coneworms also attack pines, hemlocks, Douglas-fir, and spruce.

Management—cultural control

Plant nonsusceptible conifers where this pest is a problem. Remove and destroy infested cones and twigs when possible.

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 48-50).

Hemlock *(Tsuga)*—Hemlock adelgid

Adelges tsugae

Pest description and crop damage Hemlock adelgids are aphid-like insects. They appear as white, woolly tufts on the bark and needles. Adults are black beneath the woolly material. Needles drop prematurely, weakening the tree and sometimes leading to death. Trees with severe infestations may be stressed, predisposing them to other insect and disease problems. The hemlock adelgid is especially a problem on hemlock hedges.

Biology and life history The adelgid overwinters as woolly adults, with reddish-brown crawlers similar to scale crawlers appearing in spring and early summer. Hemlock adelgids are sometimes known as “hemlock chermes.”

Management—cultural control

Western hemlock *(Tsuga heterophylla)*, mountain hemlock *(T. mertensifolia)*, and Northern Japanese hemlock *(T. diversifolia)* are reported to be resistant to infestation. Eastern or Canadian hemlock is very susceptible. Wipe off minor infestations and prune out larger infestations if possible.

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply to control crawlers after eggs hatch, usually at the time when new tip growth is expanding.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 78).

Hemlock *(Tsuga)*—Hemlock scale

Abgrallaspis ithacae

See:

Common Pests of Nursery Crops

Pest description and crop damage Hemlock scale feed on the needles of Eastern hemlock *(Tsuga canadensis)* and spruces (especially Colorado blue). Adult scale are round to oval, dark gray or black, and about 2 mm (0.1 inch) in diameter. Immature scale (crawlers) are green to yellow. Scale typically are found as small bumps on the underside of needles.

Scale feed on the needles by sucking out the cell contents. The initial symptom of infection is yellow spots on the upper surface of the needles. As few as 4 to 6 scale per needle will cause the needle to drop. Colorado blue spruce in particular loses large numbers of needles. Severe infestations may weaken trees sufficiently to cause death. The hemlock scale is most common on stressed trees.

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply to control the early summer crawler stage.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 102).

Holly *(Ilex)*—Aphid

Several species

See:

Common Pests of Nursery Crops

Holly *(Ilex)*—Brown soft scale

Coccus hesperidum

See:

Common Pests of Nursery Crops

Pest description and crop damage Flat and brown. Small, about 0.19 inch long. When abundant, presence is indicated by sooty mold.

Holly *(Ilex)*—Cottony camellia scale

Pulvinaria floccifera

See:
Common Pests of Nursery Crops

Holly *(Ilex)*—Holly bud moth

Rhopobota naevana ilicifoliana

Pest description and crop damage The adult holly bud moth is a mottled brown and black insect with a wingspan of approximately 0.5 inch. The larvae are greenish-brown with dark heads and about 0.5 inch long. The larvae roll and web leaves. Another name for the holly bud moth is blackheaded fireworm. It also feeds on cranberry, blueberry, apple, and cherry.

Biology and life history This insect overwinters as eggs which hatch in spring at which time the new caterpillars feed on buds. Older caterpillars feed on leaves, first webbing them together. The feeding damage includes rolled leaves, holes, and blackened tissue, including tip dieback. The caterpillars generally pupate in leaves on the soil although pupae can be found on occasion within the rolled leaves while on the plant. The moth generally emerges in June and then lays eggs on the leaf underside. There are two generations a year. Other hosts include apple, blueberry, cherry, Crataegus, Fraxinus, Ilex, Prunus, Pyrus, Sorbus, Spiraea, Syringa, and Vaccinium.

Management—cultural control

Hand-pick larvae when found in rolled leaves. One cultural control for this pest is to collect and dispose of the fallen leaves to reduce successful emergence from the pupae.

Management—chemical control

See:
Chemical Control of Nursery Pests

Do not spray holly in bloom. Apply when new growth is about 0.25 inch long and before blossoms open. Spreader sticker may be needed.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 206).

PNW Nursery IPM: Holly bud moth (http://oregonstate.edu/dept/nurspest/holly_bud_moth.htm)

Holly *(Ilex)*—Holly leafminer

Phytomyza ilicis

See:
Common Pests of Nursery Crops

Pest description and crop damage This species of holly leafminer feeds only on English holly *(Ilex aquifolium)*. The adult is a small, grayish black fly that emerges throughout May. Larvae are yellowish and about 0.0625 inch long. Characteristic damage by larvae includes the presence of yellow, brown, or reddish mines on the leaves. Initially, the mines are fairly narrow and winding, but become large blotches as the larvae overwinters in the leaf. The upper and lower leaf surfaces remain after feeding but are separated easily.

Biology and life history The insect overwinters as a larva in the mined leaf. It pupates in early spring, and adult flies emerge in May. A few days later, females begin laying eggs on the undersides of leaves in the midvein. The eggs hatch, and the larva burrows into the leaf and commences making the mine. They continue mining through the late fall. There is one generation per year.

Management—cultural control

Hand-pick and destroy infested leaves in the fall.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply just before bloom.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 206).

Holly *(Ilex)*—Leafroller

Several species, including obliquebanded leafroller *(Choristoneura rosaceana)*

Pest description and crop damage Green, smooth-body larvae feed on and web new growth in spring. Seldom abundant.

Management—chemical control

See:
Chemical Control of Nursery Pests

Holly *(Ilex)*—Lecanium scale

Lecanium spp.

See:
Common Pests of Nursery Crops

Honey locust *(Gleditsia triacanthos)*—Honey locust plant bug

Blepharidopterus (Diaphnocoris) chlorionis

Pest description and crop damage Small green plant bugs, overwintering as eggs. As honey locust buds expand, eggs hatch and nymphs feed on new growth. Adults can be found a month after nymphs first appear; they also feed on new growth. Feeding can cause stippling and growth distortion. Heavy feeding can cause defoliation. There is one generation per year.

Management—physical control

Nymphs can be knocked off leaves with a high-pressure spray of water.

Management—chemical control

See:
Chemical Control of Nursery Pests

Timing is focused on the newly expanding buds, targeting nymphs.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 404).

PNW Nursery IPM: Honeylocust plant bug (http://oregonstate.edu/dept/nurspest/honeylocust_plant_bug.htm)

Honey locust *(Gleditsia triacanthos)*—Honey locust pod gall midge

Dasineura gleditchiae

Pest description and crop damage A tiny midge, or fly, that develops in leaves, deforming them. There are multiple generations each year, as little as 3 to 4 weeks apart. Thornless varieties of honey locust are especially subject to damage.

Management—chemical control

There are several strategies to midge management. One strategy is to target the overwintering larvae with a drench application prior to the emergent of the adults in the April. Another management tactic is to protect new foliage with insecticide. Horticultural oil applications applied to smother eggs have also proven efficacious. Sometimes repeat applications are needed, at 2 to 4 weeks, beginning late spring.

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 466).

PNW Nursery IPM: Honeylocust pod gall midge (http://oregonstate.edu/dept/nurspest/Honey_Locust_Pod_Gall_Midge.htm)

Ivy *(Hedera)*—Aphid

Ivy aphid *(Aphis hederae)*

See:
Common Pests of Nursery Crops

Pest description and crop damage Soft-body, greenish aphid.

Japanese holly (*Ilex*)—Spider mite

Twospotted spider mite *(Tetranychus urticae)* and others

See:
Common Pests of Nursery Crops

Juniper *(Juniperus)*—Aphid

Cinara spp.

See:
Common Pests of Nursery Crops

Pest description and crop damage The aphids that infest junipers are large insects, up to 0.2 inch long. Color may range from gray to brownish to dark. The aphids establish large colonies on the twigs but rarely are found feeding on scales.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 82).

Juniper *(Juniperus)*—Cypress tip moth and allies

Argyresthia cypressella

See:
Arborvitae *(Thuja)*—Cypress tip moth

Management— cultural control

American arborvitae *(Thuja occidentalis)* is very susceptible to infection. Western red cedar *(Thuja plicata)* is very resistant.

Juniper *(Juniperus)*—Juniper scale

Carulaspis juniperi

See:
Common Pests of Nursery Crops

Pest description and crop damage The female scale is approximately 0.05 to 0.1 inch in diameter and white in color with a notable, central yellow spot. The male scale has a more elongated appearance. This insect feeds on the sap within the stem or leaf. Leaves, twigs, branches, and cones may be attacked. Their feeding can reduce the vigor of the foliage supported by that stem. Symptoms of scale feeding include loss of normal color and luster of foliage, no new growth, and yellowing and death of branches. Severe infestations may kill entire plants.

Biology and life history The insect overwinters as a mature female, filled with eggs. The crawlers emerge in late spring. There is one generation per year.

Management—cultural control

Keep plants healthy in order to resist infection better. Remove small infestations by hand, and cut out heavily infested branches.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply to control the immature crawler stage, usually in late spring to early summer. Scout for crawlers and gather life history data.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 106).

Juniper *(Juniperus)*—Juniper tip midge

Oligotropus betheli

Pest description and crop damage The adult is a tiny, yellow, mosquito-like fly. The larva is a maggot which lacks legs or a definite head. Juniper tip midge larvae feed in the tips of shoots, causing them to swell and form green galls. After the larvae have left, the galls turn brown (sometimes reddish) and the tips die back. Symptoms of mining and exit holes may be found at the junction between living and dead tissue or at the base of the swollen portion. The damage may appear very similar to that caused by fungal pathogens in the genus Phomopsis.

Management—cultural control

Remove green galls and damaged tips.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 46).

Juniper *(Juniperus)*—Juniper webworm

Dichomeris marginella

Pest description and crop damage The adult juniper webworm is a copper-brown moth with white bands on the edges of the front wings. The moth is about 0.5 inch across. The larva is a yellowish to brownish caterpillar with dark brown lines on the back and a dark head. The webworm caterpillars initially feed by mining inside leaves, then gather to feed in small colonies or nests of webbed foliage as they mature. Due to their habit of feeding deep in the plant canopy, damage may be overlooked easily. Damaged foliage turns brown and is covered with dirty webbing. Considerable amounts of foliage may be spun together, and small trees may be completely webbed. Damage frequently is observed in early spring, March to May. This pest infests only Juniperus.

Biology and life history The caterpillars overwinter in the nest, which consists of webbed twigs, and resume feeding in spring. They pupate, and adult moths are flying in late spring. Eggs are laid on leaves of the current season's growth. Larvae feed first as leafminers, then feed on the surface of leaves, building silken tubes around the feeding site. They overwinter in small groups in these webbed sites. There is one generation per year.

Management—cultural control

Hand-pick caterpillars and prune out infested growth. Irish juniper (*J. chinensis* 'Stricta') is the preferred host, although Chinese juniper, red cedar, and *Juniperus communis* varieties *aurea, horizontalis, depressa, hibernica, suecia, and squamata meyeri* also are infested. *Juniperus procumbens* and *J. squamata* are infested only occasionally.

Management—chemical control

See:

Chemical Control of Nursery Pests

Sprays applied in late fall, winter, or early spring at relatively low temperature are effective against this pest.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 30).

Juniper *(Juniperus)*—Spider mite

Oligonychus ununguis

See:

Common Pests of Nursery Crops

Management—chemical control

See:

Chemical Control of Nursery Pests

Often difficult to control unless the sprayer can drive the spray into dense foliage.

Kinnikinnick *(Arctostaphylos)*—Aphid

Includes manzanita leafgall aphid (*Tamalia coweni*)

See:

Common Pests of Nursery Crops

Pest description and crop damage Aphids are grayish or greenish and prefer new growth. The manzanita leafgall aphid feeds on the leaves of kinnikinnick and other manzanita species (*Arctostaphylos* spp.). Aphids feeding causes the leaves to thicken and form bright red galls. Older galls turn brown. Severe infestations may slow the growth of the plant. Non-gall-forming aphids also may be seen occasionally on kinnikinnick. They are greenish, soft-bodied insects that may feed on leaves or stems. Honeydew, a sweet, sticky material, may be associated with aphid feeding. It may attract ants or become covered with a growth of dark, sooty mold.

Management—biological control

See:

Biological Control of Nursery Pests

Management—cultural control

Prune off and destroy galls where seen. Avoid frequent shearing and overfertilization, which encourages succulent new growth favored by aphids. For other aphid pests, wash aphids from plants with a strong stream of water or by hand-wiping. Avoid excessive watering, and use slow-release or organic sources of nitrogen. Control ants, which "farm" aphids and protect them from predators in order to harvest their honeydew.

Management—chemical control

See:

Chemical Control of Nursery Pests

Spray in spring to protect new foliage. It is important to cover foliage thoroughly, including lower leaf surfaces.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 298).

Laurel, Portuguese *(Prunus)*—Carnation tortrix

Cacaecimorpha pronubana

Pest description and crop damage Portuguese laurel *(Prunus lusitanica)* sometimes is infested with the larvae of the carnation tortrix, a small, bell-shape brown moth with reddish underwings and dark bands on the upper wings. The caterpillars are light brown or greenish with brown heads and are about 0.375 to 0.5 inch long at maturity. The larvae feed by rolling leaves and tying them with webbing. The larvae are very active when disturbed. The carnation tortrix attacks many broad-leaved evergreen plants, but seldom causes serious damage. Larvae are active year round. Outside the U.S., this has been a serious pest of carnations and is found on hosts including apple, pear, and citrus.

Management—cultural control

Pick off larvae when found.

Management—chemical control

See:
Chemical Control of Nursery Pests

Laurel, Portuguese *(Prunus)*—Peachtree borer

Synanthedon exitiosa

See:
Apricot, flowering *(Prunus)*—Peachtree borer

Lilac *(Syringa)*—Lilac leafminer

Caloptilia syringella

See:
Common Pests of Nursery Crops

Pest description and crop damage Adult is a small, brownish moth. Greenish larvae mine and roll leaves down at tips. Leaf mining results in large, brown blotches. Ligustrum, Deutzia, Euonymus, Sorbus, and Fraxinus also may be attacked.

Biology and life history The insect overwinters as a pupa or larva, often in the mined leaf. The adult moth is found throughout the summer months. Eggs are laid along the midrib and other veins of the leaf. The larvae hatch and commence mining the leaves. There are several generations per year.

Management—chemical control

Be sure to wet undersides of leaves as well as tops. Spray all leaves to the dripping point. Repeat as necessary. Spray when blotch mines first are noticed or at least before leaves fall.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 196).

Lilac *(Syringa)*—Oystershell scale

Lepidosaphes ulmi

See:
Common Pests of Nursery Crops

Linden *(Tilia)*—Aphid

Eucallipterus tiliae

Pest description and crop damage The linden aphid is green with black lateral stripes. The aphid feed in colonies on the undersides of leaves. Feeding damage to the plant is usually minor, although some leaf and shoot distortion can occur if populations are high. Aphid also produce honeydew, a sweet, sticky secretion that collects on plant tissues and encourages growth of a black sooty mold. This can interfere with photosynthesis of the plant.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 302).

Linden *(Tilia)*—Linden gall mite

Linden gall mite *(Phytoptus tillae)*

Pest description and crop damage A very tiny mite that causes red to greenish galls on leaves. Damage is seldom serious.

Management—chemical control

No controls are registered.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 482-488).

Linden *(Tilia)*—Spider mite

Tetranychus spp.

See:
Apricot, flowering *(Prunus)*—Spider mite

Madrone *(Arbutus)*—Madrone leafminer

Marmara arbutiella

See:

Common Pests of Nursery Crops

Pest description and crop damage The adult is a moth. Larvae of this leaf- and twig-mining moth blaze sinuous, serpentine mines across the undersides of leaves. Although damage is unsightly on individual leaves, they do not affect the long-term health of the tree. This moth affects madrone throughout its range.

Management—chemical control

See:

Chemical Control of Nursery Pests

Maple *(Acer)*—Aphid

Includes Norway maple aphid *(Periphyllus lyropictus)*

See:

Common Pests of Nursery Crops

Pest description and crop damage These aphids are black, soft-body insects on leaves; sticky secretions on leaves and under trees.

Management—chemical control

See:

Chemical Control of Nursery Pests

It is important to cover foliage thoroughly, including lower leaf surfaces. Apply oils during delayed-dormant period.

For more information

PNW Nursery IPM: Periphyllus aphid on maple (http://oregonstate.edu/dept/nurspest/Periphyllus_aphid.htm)

Maple *(Acer)*—Cottony maple scale

Pulvinaria innumerabilis

See:

Common Pests of Nursery Crops

Pest description and crop damage Mature cottony maple scale are small, flat, oval, brown insects 0.25 to 0.375 inch in diameter. The “cotton” is really waxy threads, and the ovisac may contain over 1,500 eggs. The insects produce copious amounts of honeydew which can collect on foliage and branches and cause growth of sooty mold. Honeydew is also a nuisance when it falls on nearby cars and sidewalks, and it also attracts bees, wasps, and ants.

Occasionally, heavy outbreaks of this scale occur, usually on weakened or stressed trees. These outbreaks can cause the death of numerous small branches and occasionally the death of a tree.

Cottony maple scale reach epidemic numbers on silver maple, but noticeable populations can occur on red maple. It also is known to survive on other species of maple, honey and black locust, white ash, euonymus, oak, boxelder, dogwood, hackberry, sycamore, beech, elm, willow, basswood, and poplar.

Biology and life history Eggs hatch from mid-June to August and the crawlers emerge. The crawlers walk onto the leaves and tend to attach alongside the major leaf veins, usually on the underside. Here, the nymphs produce copious amounts of honeydew and grow by molting once. In September, the male scale emerge as tiny, winged, gnat-like insects that move around on the leaves in search of females. After mating, the males die and the females soon withdraw their mouthparts and crawl back onto small twigs and branches to overwinter.

Scouting and thresholds Inspect twigs during the dormant season for scale. Pay particular attention to weak plants. The crawlers are best observed during summer with a 10X magnifying glass.

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply from June through summer.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 342).

Maple *(Acer)*—Maple bladdergall mite

Vasates quadripedes

Pest description and crop damage The maple bladdergall mite is a tiny eriophyid mite that feeds on the underside of leaves. Infested leaves initially develop small depressions which soon grow into brilliant red galls 0.125 to 0.25 inch in length. Later in the season, the galls may turn green or black. Silver and red maples are particularly susceptible to bladdergall mites. Severe infestations may cause leaves to become somewhat distorted. Although an aesthetic concern, bladdergalls are seldom harmful to the trees.

Biology and life history The mites overwinter in cracks and under bark scale and begin feeding in spring. Mite activity typically stops by around July.

Management—cultural control

Hand-pick severely infested or distorted leaves to improve appearance of small trees.

Management—chemical control

Spray in early spring before buds open

Management—chemical control

See:
Chemical Control of Nursery Pests

Spray in early spring before buds open.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 482).

PNW Nursery IPM: Maple bladder gall mite (http://oregonstate.edu/dept/nurspest/maple_bladder_gall_mite.htm)

Maple *(Acer)*—Maple shoot moth

Proteoteras aesculana

Pest description and crop damage Maple tip moth, *Proteoteras aesculana* Riley, also known as maple shoot borer and maple twig borer, is an occasional pest in nursery production in the Pacific Northwest. The moths are dark olive green with yellow and gray mottling. Larvae are pale white to gray and approximately 10 mm long when mature. The head is dark brown and the thoracic shield, yellow-brown. Damage occurs when the caterpillar bores into new growing terminals, causing tip dieback. New terminals must then be trained adding to labor time and costs. Hosts include maple, specifically red maple, silver maple, sugar maple, bigleaf maple, and boxelder

Biology and life history In Oregon the moths are reported to emerge in July and August. Management is difficult as the larvae enter the shoots soon after emergence of the first two pair of leaves.

Management—chemical control

Recommendations from the work in Tennes*see* are that applications of protective insecticides be applied when the first two pair of leaves have come out. Another application 5-7 days later may be necessary on seedling trees due to seedling growth variability.

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 200).

PNW Nursery IPM: Maple tip moth (http://oregonstate.edu/dept/nurspest/maple_tip_borer.htm)

Maple *(Acer)*—Western flower thrips

Frankliniella occidentalis

Pest description and crop damage Adults are yellow to yellow-brown, 0.05 inch long, narrow, with wings. Larvae are smaller and wingless. Both stages feed on developing growth causing leaf distortion and black necrotic tissue. Most damage occurs when thrips disperse as nearby grass fields are harvested in the summer.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

PNW Nursery IPM: Thrips (http://oregonstate.edu/dept/nurspest/thrips.htm)

Mountain ash *(Sorbus)*—Aphid

Several species

See:
Common Pests of Nursery Crops

Mountain ash *(Sorbus)*—Pear leaf blister mite

Eriophyes pyri

Pest description and crop damage The leaf blister mite is a very tiny, white, sausage-shape eriophyid mite. They are seldom visible to the unaided eye. Eriophyid mite feeding on the underside of mountain ash leaves causes development of blisters on the upper leaf surface. These raised spots are generally light green, round, and look somewhat wrinkled. Older leaf blisters may turn brown. Severe infestations may result in premature leaf drop.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 482-488).

PNW Nursery IPM: Pear blister mites (http://oregonstate.edu/dept/nurspest/pear_leaf_blister_mite.htm)

Narcissus *(Narcissus)*—Narcissus bulb fly

Merodon equestris

Pest description and crop damage The adult narcissus bulb fly is about 0.5 inch long and closely resembles a small bumblebee. The larva is yellowish-white and 0.75 inch long. The maggots burrow into the bulbs near the basal plate and feed inside the bulbs, destroying bulb scale and flower parts. Infested bulbs may develop a few, grassy-looking leaves if the bulb is not too badly damaged. Severely damaged bulbs are soft, brown, and decayed. The narcissus bulb fly attacks amaryllis, daffodil, Galtonia, hyacinth, iris, lily, Leucojum, Narcissus, Scilla, tulip, and Vallota.

Biology and life history The female lays eggs near the bulbs during May or early June. The eggs hatch into grubs that move down into the soil and burrow into the base of the bulb to feed there, reducing the bulb's center to a rotten mass. In the process, the embryonic flowers that would have unfolded the following spring are destroyed. After feeding, larvae leave the bulb to pupate in the soil. In the spring, the grubs emerge as adult flies to mate and lay eggs.

Management—cultural control

Narcissus fly can be evaded by deep planting (10 inches). Plant in open areas exposed to wind. Bulb flies are usually less of a problem in such sites. Covering foliage of plants with a row cover after bloom prevents egg-laying. Plant only firm, healthy bulbs. Soft bulbs may be infested from the previous season. Destroy any soft bulbs to prevent emergence of adult bulb flies.

Management—chemical control

Apply when adults become active (early May–June). Direct stream to base of plants.
cyfluthrin (Decathlon)

Oak, Garry *(Quercus)*—Leaf and twig gall

Includes
Andricus californicus
Bassettia ligni
Besbicus mirabilis
Neuroterus saltatorius

Pest description and crop damage Leaf galls are caused by the feeding of several species of oak gall wasp larvae. Typical galls are enlarged or swollen plant tissues. These may assume several forms, depending on the species of wasp. The main gall wasps on Oregon white oak include *Andricus californicus*, which forms large, persistent, apple-like galls on twigs; *Bassettia ligni*, which causes seed shaped galls under the bark of branches that often girdle and kill the branch; *Besbicus mirabilis*, which forms mottled, spherical galls on the underside of leaves; and *Neuroterus saltatorius*, which forms mustard-seed-like galls on lower leaf surfaces that drop in the fall and jump around like Mexican jumping beans (caused by activity of the enclosed larvae).

The California gallfly causes the largest and most conspicuous of the galls on oak, achieving a diameter of 1 to 4 inches. It is a twig gall that is often called an oak apple. It starts out green and in time becomes red on the sunny side. Later in the season, the gall turns brown or greyish just before the adult wasps chew their way out. The gall does no apparent damage to the tree and is removed easily without harming the twig. The gall usually is round, but is sometimes kidney-shape. During its development, the gall may host up to a dozen larvae.

Jumping oak galls cause small yellow spots on the upper surface of infested leaves. On the underside of the leaves are tiny seed shaped galls. These appear in midsummer or later. Inside each gall is the larvae of a tiny wasps. In the fall, the galls drop from the leaves to the ground, where the activity of the larva causes the gall to jump an inch or more off the ground. The wasps overwinter in the galls on the ground. In the spring, females lay eggs in opening oak buds. The larvae cause blister galls, deforming the leaves. Adult females emerging from these galls lay eggs on the leaves, producing the larvae which cause the jumping oak galls. Although they may be unsightly, jumping oak galls do relatively little damage.

Stem galls are caused by the feeding of several species of oak gall wasp larvae. Typical galls are enlarged or swollen. Galls associated with oak stems are often smooth and round, but may be elongate, thorny, or rough. They can be single galls or clusters of galls. Colors vary from green to reddish to brown, depending on the wasp species causing the gall and the age of the gall. Many galls also are formed on the leaves. Twigs can be weakened or killed by infestations.

Management—chemical control

carbaryl—Apply as leaves unfold in spring. Washington and Oregon only.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 440-448).

Oak, Garry *(Quercus)*—Oak skeletonizer

Bucculatrix albertiella

Pest description and crop damage This insect also is known as the oak ribbed casemaker. The adult moth is mottled white, brown, and black with a wingspread of about 0.33 inch. The mature larvae are about 0.25 inch long and pale yellow to green. Young larvae feed inside leaves, chewing away tissues and leaving a linear mine. Older larvae feed on the underside of leaves, leaving only the upper surface and veins, which turn brown. Severely damaged leaves may be almost transparent. The oak ribbed casemaker is reported on California white (valley) oak *(Quercus lobata)* and coast live oak *(Q. agrifolia)*.

Biology and life history This insect appears to pass the winter inside its characteristic cocoon. Immature larvae make flat, white, circular cocoons, while cocoons of mature larvae are white with distinctive longitudinal ribs. The latter can be found on leaves, twigs, or other nearby objects. The moths appear in spring and lay eggs on the undersides of leaves. The larvae emerge and feed on the foliage. There are two generations per year.

Management—biological control

Natural enemies probably help keep populations in check. Avoid use of broad-spectrum insecticides which kill beneficial insects.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply in early summer when caterpillars are first active.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 220).

Oak, Garry *(Quercus)*—Pit scale

Asterolecanium spp.

See:
Common Pests of Nursery Crops

Pest description and crop damage Adult scale are covered with a hard shell and are about 0.06 inch in diameter. They may be brown, gold, or greenish. They feed on twigs and small branches, with young wood most commonly infested. Pit scale feeding causes the tissue of the twig to swell around the insect. The growth makes the scale appear to be in a pit on the bark. Numerous scale on a twig cause it to appear roughened. Severe infestations cause twig dieback. Heavy infestations of pit scale combined with drought stress or anthracnose (a fungal disease) can result in severe weakening or death of trees.

Biology and life history Scale overwinter as mature females in pits on the twigs. Crawlers are produced in the late spring. These do not move far and typically colonize current season and 1-year-old wood. After settling to suck plant juices, the crawlers do not move for the remainder of their life cycle. There is one generation per year.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply to control the immature crawler stage, usually in late spring to early summer. Scout for crawlers and gather life history data. Adding 1% horticultural oil increases effectiveness. Trees sometimes are injured when sprayed while under stress due to drought, root pruning, etc.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 352).

Oak, Garry *(Quercus)*—Western oak looper

Lambdina fiscellaria somniaria

Pest description and crop damage The adult moth is yellowish to dark brown. Mature larvae of the western oak looper are about 1 inch long and light brown with black spots when mature. They move in a characteristic “looping” or measuring-worm fashion. The western oak looper feeds mainly on the foliage of the Oregon white (or Garry) oak *(Quercus garryana)*. It is probably the most damaging insect on white oak from Oregon north to British Columbia. In some years, oaks over large areas in the Willamette Valley are defoliated. The damage is temporary, since the trees leaf out the next year, and outbreaks are not sustained.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply sprays in July or early August when larvae are feeding.

Peach, flowering *(Prunus)*—Aphid

Includes *Myzus persicae* and other species

See:
Common Pests of Nursery Crops

Pest description and crop damage Several aphid species attack peaches, including the green peach aphid, mealy plum aphid, and rusty plum aphid. Green peach aphid adults have a black head and thorax and a green body. Nymphs are yellowish-green. Adults of the mealy plum aphid are pale bluish green with a white, powdery coating. The rusty plum aphid is rusty brown or deep purple with white bands on the legs.

The aphid feed initially on the shoot tips, which on young trees can cause stunting and malformation of the tips. On older trees, fruit set may be reduced in subsequent years if populations are high, and honeydew production can cause sooty mold problems on fruit. Green peach aphid is a bigger problem on nectarines and on summer vegetable crops, for which it is an important vector of some virus diseases.

Biology and life history The aphid overwinter as eggs in crevices and twigs. The eggs hatch near budbreak, and the nymphs feed on unopened buds and the underside of the leaves. The leaves curl and protect the aphid as they feed. After two to three generations, winged forms are produced that migrate to summer hosts which include weeds, ornamental plants, vegetables, or plants of the mustard family (in the case of black cherry aphid). After several more generations, the winged forms migrate back in the fall to the tree fruit to mate and lay the overwintering eggs.

Scouting and thresholds Begin observing shoots prior to budbreak, as management is best done early and while the aphid are small.

Peach, flowering *(Prunus)*—Leafroller

Several species

Pest description and crop damage There are several species of leafroller pests of fruit trees. These are larvae of several moth species which use native plants as hosts as well as fruit trees. They all cause similar damage to the trees but differ in their appearance and, more importantly, in their life cycle. The principal leafroller pests of tree fruits can be divided into single-generation moths, such as the fruittree leafroller and the European leafroller, and two-generation moths, such as the obliquebanded leafroller and threelined leafroller. Adults of these species range from fawn-color to dark brown. There are distinctive bands or mottling on the wings. Wing spans range from 0.5 to 1 inch. The larvae of these species are all green caterpillars with a light brown to black head, depending on species.

As the name leafroller implies, the larvae roll and tie leaves together for shelter and feeding. They thrash about violently when disturbed and may drop from the leaf suspended by a silken thread. Feeding on growing points on young plants can promote undesirable branching. Newly hatched larvae may work into blossoms and damage developing fruit, which then abort and fall off the tree. Larvae of the summer generation of the three-lined and obliquebanded leafrollers feed on the surface of fruit just before harvest.

Biology and life history The single-generation leafrollers overwinter as egg masses on twigs and branches. Eggs hatch in spring as buds are opening and hatch is completed by petal fall. The larvae feed for 4 to 6 weeks, then pupate in the rolled leaves and emerge as moths in early summer. The overwintering eggs are laid in July. Two-generation leafrollers overwinter as immature larvae under the bark on scaffold branches of a variety of host plants. Larvae may feed during warm periods in winter, but become active in spring with onset of new growth. They feed for several weeks, then pupate in rolled leaves. Adult moths emerge in late April–May. These lay eggs for the next generation. The next generation hatches in early summer and does the most damage.

Scouting and thresholds Observe early spring growth for rolled leaves and feeding damage on new growth.

Management—biological control

Very low temperatures in winter significantly reduce overwintering populations of larvae. Spiders and parasitic wasps, as well as predators like the brown lacewing, greatly reduce leafroller populations throughout the year.

See:
Biological Control of Nursery Pests

Management—cultural control

Hand-pick rolled leaves containing larvae or pupae. Removal of overwintering sites, such as rolled leaves on the ground or plastered to tree trunks, can reduce next year's population.

Management—chemical control

See:
Chemical Control of Nursery Pests

Peach, flowering *(Prunus)*—Peach silver mite

Vasates cornutus

Pest description and crop damage Peach silver mites are tiny, four legged eriophyid mites, yellow to pinkish white, and somewhat wedge-shaped. On rare occasions when very high populations of peach silver mite survive the winter, they produce symptoms on the unfolding leaves. Symptoms consist of minute, yellow spots and a tendency for the leaf edges to curl toward the midrib. Ordinarily, however, most injury is not noticed until mid- to late summer, when heavily infested leaves take on a silvery appearance.

Biology and life history The mites overwinter as females in bark crevices, around buds, and under bud scale. They move to the leaves soon after budbreak in spring. Later in the season, they are found primarily on the lower leaf surface. Before leaf fall, females move to overwintering sites. Many generations are produced during the season.

Management—biological control

Treatments applied specifically for control of peach silver mite rarely are needed and should be avoided, because peach silver mites serve as early season food for predaceous mites, which in turn aid in reducing populations of other pest mites. The use of broad-spectrum insecticides for other pests can cause high infestations of peach silver mite.

Management—chemical control

See:
Chemical Control of Nursery Pests

Peach, flowering *(Prunus)*—Peachtree borer

Synanthedon exitiosa

See:
Apricot, flowering *(Prunus)*—Peachtree borer

Peach, flowering *(Prunus)*—Peach twig borer

Anarsia lineatella

See:
Apricot, flowering *(Prunus)*—Peach twig borer

Peach, flowering *(Prunus)*—Spider mite

Tetranychus spp.

See:
Apricot, flowering *(Prunus)*—Spider mite

Photinia *(Photinia)*—Aphid

See:
Common Pests of Nursery Crops

Photinia *(Photinia)*—Root weevil

See:
Common Pests of Nursery Crops

Pine *(Pinus)*—Black pineleaf scale

Nuculaspis californica

See:
Common Pests of Nursery Crops

Pest description and crop damage Mature scale are almost circular, 0.06 inch in diameter, and yellowish brown to black. Young hatch in spring and summer. This insect attacks various species of pine, ponderosa most commonly, as well as Douglas-fir and hemlock.

See "Pine" in:
Christmas Tree Plantation Pests

Management—biological control

See:
Biological Control of Nursery Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply to control crawler stage, usually in spring and summer.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 100).

Pine *(Pinus)*—Coneworm

Dioryctria spp.

Pest description and crop damage Small, brownish cream larvae of shoot moths that bore into fresh green cones. They also may bore into trunk cambium, branches, and shoots.

See "Pine" in:
Christmas Tree Plantation Pests

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 48).

Pine *(Pinus)*—Eriophyid mites

Trisetacus spp.

Pest description and crop damage Microscopic, torpedo-shape mites that feed in needle sheaths, yellowing and distorting new needles.

See "Pine" in:

Christmas Tree Plantation Pests

Management—chemical control

carbaryl/oil has been used with success when applied three times about a week apart from mid-May into early June, or when new candles have elongated but before needles have fully elongated.

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 122).

Pine *(Pinus)*—European pine shoot moth

Rhyacionia buoliana

Pest description and crop damage Of concern mainly to pine tree exporters. May cause moderate flagging. Boring larvae kill tips of terminals and laterals. Small trees may be killed. One generation per year.

See "Pine" in

Christmas Tree Plantation Pests

Sampling and thresholds Pheromone lures and traps and degree-day models are available to monitor for adult flight. Successful management depends on applications that coincide with adult moth flight.

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 48-50).

Pine *(Pinus)*—Pandora moth

Coloradia pandora

Pest description and crop damage Large, heavy-body moth. Large, brown to yellowish green, spiny larvae feed on needles and may defoliate during outbreak years. Requires 2 years to complete life cycle. Control not needed except in outbreak years.

See "Pine" in:

Christmas Tree Plantation Pests

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 26).

Pine *(Pinus)*—Pine aphid

Cinara strobi

See:

Common Pests of Nursery Crops

Pest description and crop damage Colonies form in groups on needles. An extensive infestation yellows the tree and promotes sooty mold.

See "Pine" in:

Christmas Tree Plantation Pests

Management—biological control

See:

Biological Control of Nursery Pests

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 84).

Pine *(Pinus)*—Pine bark adelgid

Pineus strobi

Pest description and crop damage White, cottony masses on bark of trunk, branches, or twigs.

See "Pine" in:

Christmas Tree Plantation Pests

Management—chemical control

See:

Chemical Control of Nursery Pests

Spray in early spring at or near bud break. Thorough coverage is necessary. Difficult to control with anything other than high-pressure spray equipment.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 76).

Pine *(Pinus)*—Pine butterfly

Neophasia menapia

Pest description and crop damage A dark green caterpillar with two white stripes down each side feeds on needles. They do little damage except during outbreak years.

See "Pine" in:

Christmas Tree Plantation Pests

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 24).

Pine *(Pinus)*—Pine needle scale

Chionaspis pinifoliae

See:

Common Pests of Nursery Crops

Pest description and crop damage Elongate, flat, white scale on leaves. May cause severe damage. Pine needle scale also attacks spruce, fir, and occasionally cedar.

See "Pine" in:

Christmas Tree Plantation Pests

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply to control the immature crawler stage, usually in late spring to early summer. Scout for crawlers and gather life history data.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 108).

PNW Nursery IPM: Pine needle scale (http://oregonstate.edu/dept/nurspest/pine_needle_scale.htm)

Pine *(Pinus)*—Pine sheath miner

Zelleria haimbachi

Pest description and crop damage Larvae are bright orange; mature insects are tan. Adults lay eggs on needles from early to midsummer. First they mine the needle, then they sever the sheath.

See "Pine" in:

Christmas Tree Plantation Pests

Management—chemical control

malathion

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 38).

Pine *(Pinus)*—Powdery pine needle aphid

Eulachnus rileyi

See:

Common Pests of Nursery Crops

Pest description and crop damage Powdery gray aphid, active all season, causes early needle drop.

See "Pine" in:

Christmas Tree Plantation Pests

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 84).

Pine *(Pinus)*—Sequoia pitch moth

Synanthedon sequoiae

Pest description and crop damage Larvae of a clearwing moth feed in tree limbs and trunks. Trees under attack are almost always previously stressed. A mass of pinkish pitch at the feeding site is evidence of infestation.

See "Pine" in:

Christmas Tree Plantation Pests

Sampling and thresholds Pheromone traps are available.

Management—cultural control

Keep trees vigorous.

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply materials to the trunk and lower limbs. Avoid contacting foliage. Apply generally in late spring or when adults are active.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 72).

PNW Nursery IPM: Sequoia pitch moth (http://oregonstate.edu/dept/nurspest/sequoiapitchmoth.htm)

Pine *(Pinus)*—Spider mite

Oligonychus spp.

See:

Common Pests of Nursery Crops

See "Pine" in:

Christmas Tree Plantation Pests

Pine *(Pinus)*—White pine weevil

Pissodes strobi

Pest description and crop damage Adults are about 0.25 inch long and light to dark brown with a prominent curved back. They kill terminal shoots and deform the tree.

See "Pine" in:

Christmas Tree Plantation Pests

Management—cultural control

Remove and burn infested shoots.

Management—chemical control

See:

Chemical Control of Nursery Pests

Control requires thorough applications to the terminals to prevent new infestations by egg-laying female weevils.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 54).

PNW Nursery IPM: White pine weevil (http://oregonstate.edu/dept/nurspest/white_pine_weevil.htm)

Plum, flowering *(Prunus)*—Hop aphid

Phorodon humuli

See:

Common Pests of Nursery Crops

Pest description and crop damage Soft-body, bluish green insect found on the underside of leaves or in rolled leaves. Heavy infestations cause severe defoliation.

Management— biological control

See:

Biological Control of Nursery Pests

Management—chemical control

See:

Chemical Control of Nursery Pests

It is important to cover foliage thoroughly, including lower leaf surfaces. Difficult to control unless applications are made in early spring before leaves are rolled. Apply oils in dormant or delayed-dormant periods.

Plum, flowering *(Prunus)*—Leaf curl plum aphid

Anuraphis helichryse

See:

Common Pests of Nursery Crops

Pest description and crop damage Causes extreme leaf curling.

Management— biological control

See:

Biological Control of Nursery Pests

Management—chemical control

To be effective, applications must be made early, before leaves curl. It is important to cover foliage thoroughly, including lower leaf surfaces. Apply oils in dormant or delayed-dormant periods.

See:

Chemical Control of Nursery Pests

Plum, flowering *(Prunus)*—Peachtree borer

Synanthedon exitiosa

See:

Apricot, flowering *(Prunus)*—Peachtree borer

Plum, flowering *(Prunus)*—Pear sawfly

Caliroa cerasi

See:

Cherry, flowering *(Prunus)*—Pear sawfly

Plum, flowering *(Prunus)*—Scale

Various species

See:

Common Pests of Nursery Crops

Poplar *(Populus)*—Carpenterworm

Prionoxystus robinae

Pest description and crop damage Large white larva (1 to 3 inches) bores 0.5-inch-diameter holes in trunk and main branches and eventually kills trees. Adult moth is speckled gray. Three-year life cycle.

Management—cultural control

Keep trees vigorous.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply preventive spray to major branches and trunk as well as to crown of small trees. Apply in early June and early July.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 256).

Poplar *(Populus)*—Lettuce root aphid

Pemphigus spp.

See:
Common Pests of Nursery Crops

Pest description and crop damage Aphids cause flask-shape galls on leaf petioles. Galls are not hazardous to trees.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 460).

Poplar *(Populus)*—Oystershell scale

Lepidosaphes ulmi

See:
Common Pests of Nursery Crops

Poplar *(Populus)*—Poplar-and-willow borer

Cryptorhyncus lapathi

Pest description and crop damage Larvae bore under bark and into wood. They weaken and break limbs.

Scouting and thresholds Entry holes and borer damage greatly affect marketability; action thresholds are very low. Prevention is key.

Management—cultural control

Keep trees vigorous.

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply materials to the trunk and lower limbs. Avoid contacting foliage. Apply from mid-June to August, when adults are active.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 268).

PNW Nursery IPM: Poplar-and-willow borer (http://oregonstate.edu/dept/nurspest/poplar_and_willow_borer.htm)

Poplar *(Populus)*—Satin moth

Leucoma salicis

Pest description and crop damage Brownish caterpillars with white spots on back.

Management—chemical control

See:
Chemical Control of Nursery Pests

Spray in late summer when larvae are seen.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 158).

Privet *(Ligustrum)*—Lilac leafminer

Caloptilia syringella

For more information

See:
Lilac *(Syringa)*—Lilac leafminer

Privet *(Ligustrum)*—Thrips

Caloptilia syringella

Pest description and crop damage Slender and straw color. Cause leaf distortion.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

PNW Nursery IPM: Thrips (http://oregonstate.edu/dept/nurspest/thrips.htm)

Rhododendron *(Rhododendron)*—Aphid

Masonaphis spp.

See:
Common Pests of Nursery Crops

Pest description and crop damage Green, soft-body insects. White, cast skins are conspicuous. Usually found only on new tender growth.

Management—biological control

See:
Biological Control of Nursery Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Rhododendron *(Rhododendron)*—Azalea bark scale

Eriococcus azaleae

See:
Common Pests of Nursery Crops

Pest description and crop damage White, cottony sacs enclosing small, reddish eggs.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 336).

PNW Nursery IPM: Azalea Bark Scale (http://oregonstate.edu/dept/nurspest/azalea_bark_scale.htm)

Rhododendron *(Rhododendron)*—Carnation tortrix

Cacaecimorpha pronubana

See:
Laurel, Portuguese *(Prunus)*—Carnation tortrix

Rhododendron *(Rhododendron)*—Lecanium scale

Lecanium spp.

See:
Common Pests of Nursery Crops

Rhododendron *(Rhododendron)*—Root weevil

Sciopithes obscurus, Otiorhynchus sulcatus

See:
Common Pests of Nursery Crops

Rhododendron *(Rhododendron)*—Rhododendron bud moth

Coleotechnites huntella

Pest description and crop damage Pink larvae overwinter in the larger buds. They pupate in buds or twigs in the spring. Adults are gray moths, about 0.5 inch long, appearing in July. New larvae make blotch mines covered with silk and debris on the underside of host leaves. Later, they mine the midrib and then bore into twigs and bud bases in the fall.

Management—chemical control

See:
Chemical Control of Nursery Pests

Spray in May, June, and July. Covering bottoms of leaves is essential.

Rhododendron *(Rhododendron)*—Rhododendron lace bug

Stephanitis rhododendri

Pest description and crop damage Overwinters in egg stage. Eggs are laid in the midrib on the underside of leaves. Eggs hatch in late May or early June, although they have been noted as early as mid-April. Probably one generation a year in Oregon. Leaves are yellow and stippled. Undersides of leaves are dirty.

Management—chemical control

See:
Chemical Control of Nursery Pests

Use as label directs. Apply in late spring when young nymphs appear. Difficult to control with one application.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 424).

PNW Nursery IPM: Rhododendron lace bugs (http://oregonstate.edu/dept/nurspest/lace bugsonrhodies.htm)

Washington State University: Rhododendron Lace Bug (http://www.puyallup.wsu.edu/plantclinic/resources/pdf/pls120rhodylace bug.pdf)

Rhododendron *(Rhododendron)*—Rhododendron whitefly

Dialeurodes chittendeni

Pest description and crop damage Small white insects with wings held roof-like over their heads. The eggs are small and white and laid on the underside of the leaf. Once the eggs hatch, the small oval nymphs settle and remain stationary, feeding at that site. Honeydew can be present with the associated black sooty mold fungus. The insect overwinters in the nymph stage. There is one generation a year.

Management—chemical control

See:
Chemical Control of Nursery Pests

Several applications may be necessary, about 5 to 7 days apart.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 318).

Rose *(Rosa)*—Leafcutting bee

Megachile spp.

Pest description and crop damage Smooth, circular, or crescent-shape areas are cut from leaves. Bees use pieces of leaves to form cells for young.

Management—chemical control

No controls are registered.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 494).

Rose *(Rosa)*—Leafroller

Many species

Pest description and crop damage Variously colored caterpillars about 0.75 inch long when mature.

Management—chemical control

See:
Chemical Control of Nursery Pests

Rose *(Rosa)*—Raspberry cane maggot

Pegomya rubivora

Pest description and crop damage New shoots wilt from a few inches to a foot from the tip. Damage is caused by a small white maggot that girdles the cane. This usually is not a serious pest. It is more often a pest of blackcaps and other cane fruits.

Management—cultural control

Cut off infested canes several inches below the wilted portion.

Rose *(Rosa)*—Redhumped caterpillar

Schizura concinna

Pest description and crop damage Mature larvae are reddish or yellow and have several spines on each segment. The entire body is lined with white, dark reddish brown, and black lines. The head is red, and the fourth segment is humped. This insect has been a problem on cherry and other hosts east of the Cascade Mountains.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 156).

Rose *(Rosa)*—Rose aphid

Macrosiphum rosae

See:
Common Pests of Nursery Crops

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 308).

Rose *(Rosa)*—Rose curculio

Merhynchites bicolor

Pest description and crop damage Bright red beetle, 0.25 inch long, with black undersurface, head, and legs, and long snout. One form is entirely black. Adults make egg punctures in buds, which may fail to open. Usually not a serious pest.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 238).

PNW Nursery IPM: Rose curculio (http://oregonstate.edu/dept/nurspest/rose_curculio_weevil.htm)

Rose *(Rosa)*—Rose leafhopper

Edwardsiana rosae

Pest description and crop damage Adult insect is greenish white; immature stages are the same color, flat, and elongate. Leaves look stippled. Heavy infestations result in defoliation.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 412).

Rose *(Rosa)*—Rose midge

Dasineura rhodophaga

Pest description and crop damage The adult midge lays its eggs inside the sepals of new flower and leaf buds. The tiny maggot that hatches feeds in these areas causing blackened tissue, tip abortion, and distorted flower buds. There are two peaks of damage: in late June/early July and late August/early September.

Management—cultural control

Buy in bare-root or rinse off and dispose of container media when new plant material is brought in during the time midges are overwintering. Cut out and destroy infected tips. There are some roses with more resistance to the midge.

Management—chemical control

There are several strategies to midge management. One strategy is to target the overwintering larvae with a drench application prior to the emergent of the adults in the spring. Another management tactic is to protect new foliage with insecticide. Sometimes repeat applications are needed, at 2 to 4 weeks, if damage continues.

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 470).

PNW Nursery IPM: Rose midge (http://oregonstate.edu/dept/nurspest/rose_midge.htm)

Rose *(Rosa)*—Rose sawfly

Endelomyia aethiops

Pest description and crop damage Larvae are slug-like and light green. They skeletonize leaves or make holes in leaves.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 132).

PNW Nursery IPM: Rose slug (http://oregonstate.edu/dept/nurspest/roseslug.htm)

Rose *(Rosa)*—Rose stem miner

Marmara spp.

Pest description and crop damage Adult is a small moth. Larvae make winding mines beneath the epidermis. Seldom a serious problem.

Management—cultural control

If mines detract from the plant's appearance, prune and destroy infested canes.

Management—chemical control

No control measures have been developed.

Rose *(Rosa)*—Rose thrips

Frankliniella spp.

Pest description and crop damage Slender, tiny, straw-color insects in buds and blooms cause distortion of leaves and flowers.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

PNW Nursery IPM: Thrips (http://oregonstate.edu/dept/nurspest/thrips.htm)

Rose *(Rosa)*—Small carpenter bee

Ceratina spp.

Pest description and crop damage Small bees, 0.37 inch long and metallic blue or blue-green, burrow into the pith of cut stems and make cells for young. Cells are provisioned with pollen and nectar. Damage is not serious and is only in pruned stems.

Management—cultural control

Cover cut stems with wax to prevent burrowing and egg laying.

Prune out damaged canes.

Rose *(Rosa)*—Spider mite

Tetranychus spp. and *Panonychus ulmi*

See:

Apricot, flowering *(Prunus)*—Spider mite

Rose *(Rosa)*—Western spotted cucumber beetle

Diabrotica undecimpunctata

Pest description and crop damage Yellowish green beetles with black spots. Feed on blossoms.

Management—chemical control

See:

Chemical Control of Nursery Pests

For more information

PNW Nursery IPM: Western spotted cucumber beetle (http://oregonstate.edu/dept/nurspest/western_spotted_cucumber_beetle.htm)

Sequoia/redwood *(Sequoia)*—Juniper scale

Carulaspis juniperi

See:

Common Pests of Nursery Crops

Pest description and crop damage Scale covering is circular, white, and about 0.06 inch in diameter. Causes foliage to turn brown and twigs to die back.

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply spray when scale crawlers begin to appear (usually early June) and repeat again 3 to 4 weeks later (early to mid-July).

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 106).

Skimmia (*Skimmia*)—Spider mite

Tetranychus spp*., Bryobia rubrioculus,* and *Panonychus citri*

See:

Common Pests of Nursery Crops

Spiraea *(Spiraea)*—Aphid

Masonaphis spiraeae

See:

Common Pests of Nursery Crops

Spiraea *(Spiraea)*—Snapdragon plume moth

Platyptilia antirrhina

Pest description and crop damage The small greenish larvae mine leaves. Later, they feed on terminal leaves and bore into developing flowers and inside the stems. Adult is grayish brown with narrow plumed wings and a 0.5 inch wingspread.

Pest biology and life cycle Adults are considered weak fliers. They tend to remain on or near the host plant. They are most active during early evening. Single eggs are usually deposited on new forming flower heads or underside of leaves near new growth. It takes 2-4 weeks for the eggs to hatch and the new larvae burrow into stems, flower buds, and seed heads where the larvae feed and develop for about 3-5 weeks. Caterpillars pupate while hanging from plants. Adult is the overwintering stage.

Management—chemical control

See:

Chemical Control of Nursery Pests

Spiraea *(Spiraea)*—Spider mite

Tetranychus spp.

See:
Common Pests of Nursery Crops

Spruce *(Picea)*—Carnation tortrix

Cacaecimorpha pronubana

See:
Laurel, Portuguese *(Prunus)*—Carnation tortrix

Spruce *(Picea)*—Coneworm

Dioryctria spp.

Pest description and crop damage Small, brownish cream larvae of shoot moths bore into fresh green cones. May also bore into trunk cambium, branches, and shoots.

See "Spruce" in:
Christmas Tree Plantation Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 48-50).

Spruce *(Picea)*—Cooley spruce gall adelgid

Adelges cooleyi

Pest description and crop damage Aphid-like, with a covering of white, woolly exudate. Cone-like galls are formed at ends of twigs.

See "Spruce" in:
Christmas Tree Plantation Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply when new growth is unfolding in the spring. Once galls are forming, spraying will not control adelgids.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 112).

Spruce *(Picea)*—Douglas-fir tussock moth

Orgyia pseudotsugata

Pest description and crop damage Mature larvae are about 1 inch long, hairy, gray or light brown, with black heads. Several light brown or cream-color tufts of hair are on the body. Defoliate trees. Also attacks Douglas-fir, true firs, pine, and larch.

See "Spruce" in:
Christmas Tree Plantation Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Spruce *(Picea)*—Pine needle scale

Chionaspis pinifoliae

See:
Common Pests of Nursery Crops

Pest description and crop damage Elongate, flat, white scale on leaves. Also attacks pine, fir, and occasionally cedar.

See "Spruce" in:
Christmas Tree Plantation Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply to control the immature crawler stage usually in late spring to early summer. Scout for crawlers and gather life history data.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 108).

Spruce *(Picea)*—Silverspotted tiger moth

Halisidota argentata

Pest description and crop damage Larvae hibernate in dense clusters on twigs and become active on warm winter days. Larvae mature in June. Pine, arborvitae, and true fir also are subject to attack. Damage may be in late fall or early spring.

See "Spruce" in:
Christmas Tree Plantation Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Spruce *(Picea)*—Spruce aphid

Elatobium abietinum

See:
Common Pests of Nursery Crops

Pest description and crop damage Small, dull green aphid causes extreme needle drop. Aphid appear early in the season (about February) and may increase rapidly during March and April.

See "Spruce" in:
Christmas Tree Plantation Pests

Management—biological control

See:
Biological Control of Nursery Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Early-season control is the key to successful treatment. Usually by the time damage is noted, it is too late for effective treatment. It is important to cover foliage thoroughly, including lower leaf surfaces.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press(p. 82).

Spruce *(Picea)*—Spruce bud scale

Physokermes piceae

See:
Common Pests of Nursery Crops

Pest description and crop damage Females are semiglobular and brown and resemble buds. They produce abundant honeydew.

See "Spruce" in:
Christmas Tree Plantation Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Spray in early summer when crawlers are present.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 96).

Spruce *(Picea)*—Spruce budworm

Choristoneura occidentalis

Pest description and crop damage Green to brown larvae, up to 1 inch long, attack foliage and buds of fir and spruce.

See "Spruce" in:
Christmas Tree Plantation Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply in spring (May) when larvae feed on old needles and before they enter buds. June to July applications will control larvae on new growth.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 28).

Spruce *(Picea)*—Spruce needleminer

Endothenia albolineana

Pest description and crop damage Small, light greenish brown larvae mine and web needles. Adult moth is dark brown with a wing expanse of 0.5 inch.

See "Spruce" in:
Christmas Tree Plantation Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Apply late May or early June when moths and young larvae appear.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 32).

Spruce *(Picea)*—Spruce spider mite

Oligonychus ununguis

See:
Common Pests of Nursery Crops

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

See "Spruce" in:
Christmas Tree Plantation Pests

Spruce *(Picea)*—Webworm

Cephalcia abietis

Pest description and crop damage Larvae hibernate in dense clusters on twigs and become active on warm winter days. Larvae mature in June. Pine, arborvitae, and true firs also are subject to attack. Damage may occur in late fall or early spring.

See "Spruce" in:
Christmas Tree Plantation Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

Spruce *(Picea)*—White pine weevil

Pissodes strobi

See:
Pine *(Pinus)*—White pine weevil

Sycamore *(Platanus)*—Aphid

See:

Common Pests of Nursery Crops

Sycamore *(Platanus)*—Sycamore scale

Stomacoccus platani

See:

Common Pests of Nursery Crops

Pest description and crop damage Infested leaves become disfigured with yellow spots. Scale also feed on bark, causing twig dieback. Eggs are laid in masses of cottony wax in late winter.

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply to control the immature crawler stage, usually in late spring to early summer. Scout for crawlers and gather life history data. Oils are effective early to late spring.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 334).

Viburnum *(Viburnum)*—Bean aphid

Aphis fabae

See:

Common Pests of Nursery Crops

Pest description and crop damage Black aphids on underside of leaves on Viburnum species referred to as “Snowball.” They do not attack Viburnum davidii.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 300).

Viburnum *(Viburnum)*—Viburnum leaf beetle

Pyrchalta viburni

Pest description and crop damage Adults are brown and about 0.25 inch long. They chew oblong shotholes on the leaves. Mature larvae are greenish yellow and are about 0.37 inch long. They skeletonize leaves. This beetle, an introduced species from Canada, currently is only in northwest Washington.

Management—chemical control

See:

Chemical Control of Nursery Pests

Soil drenches are particularly effective but must be made several weeks before feeding activity is anticipated.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 224).

Viburnum *(Viburnum)*—Root weevil

Otiorhynchus spp.

See:

Common Pests of Nursery Crops

Willow *(Salix)*—Carpenterworm

Prionoxystus robinae

Pest description and crop damage Large white grub (1 to 3 inches), bores holes 0.5 inch in diameter in trunk and main branches, and eventually kills trees. Adult moth, which is speckled gray, causes no damage. Three-year life cycle.

Management—cultural control

Keep trees vigorous.

Management—chemical control

See:

Chemical Control of Nursery Pests

Apply to major branches and trunk; to trunk and crown of small trees. Apply in early June and in early July.

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 256).

Willow *(Salix)*—Giant willow aphid

Lachnus salignis and other species

See:
Common Pests of Nursery Crops

Pest description and crop damage Large gray to gray-black aphids often are in large numbers on twigs, branches, and trunk. Their legs generally are light brown. A prominent black tubercle is in the center of the back with slightly smaller tubercles on either side. Aphids may be a nuisance around homes when they collect on the sides of the house and crawl through window openings.

Management—biological control

See:
Biological Control of Nursery Pests

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 310).

Willow *(Salix)*—Poplar-and-willow borer

Cryptorhynchus lapathi

See:
Poplar *(Populus)*—Poplar-and-willow borer

Willow *(Salix)*—Satin moth

Leucoma salicis

Pest description and crop damage Adult moth is satiny white. Larvae are approximately 2 inches long when grown, reddish brown, with white patches on top and tufts of hairs along sides. They can seriously defoliate trees such as cottonwood, poplar, and willow. They occasionally attack oak and aspen.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 158).

Willow *(Salix)*—Spiny elm caterpillar (mourningcloak butterfly)

Nymphalis antiopa

Pest description and crop damage Adult is a large butterfly, with purplish brown wings bordered with a wide yellow stripe inside of which is a row of blue or purple spots. Larvae are purplish black with a row of orange or red spots along the back. They have brownish prolegs and are clothed with long, forked spines.

Management—chemical control

See:
Chemical Control of Nursery Pests

For more information

Johnson, W.T. and H.H. Lyon (1991), *Insects That Feed on Trees and Shrubs*, 2nd ed., Cornell University Press (p. 152).

Yew *(Taxus)*—Cottony camellia scale

Pulvinaria floccifera

See:
Common Pests of Nursery Crops

Yew *(Taxus)*—Lecanium scale

Lecanium spp.

See:
Common Pests of Nursery Crops

Yew *(Taxus)*—Root weevil

Otiorhynchus spp.

See:
Common Pests of Nursery Crops

Yew *(Taxus)*—Spider mite (false)

Pentamerismus taxi

Pest description and crop damage Deep red, small, short-leg mite, generally flattened. This mite generally is found on yew but also on other evergreens.

Management—biological control

Spider mites have many natural enemies, including other mites.

Management—chemical control

See:
Chemical Control of Nursery Pests

Greenhouse Ornamental Pests

Melissa Scherr and Lloyd Nackley

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In all cases, follow the instructions on the pesticide label. The PNW Insect Management Handbook has no legal status, whereas the pesticide label is a legal document. Read the product label before making any pesticide applications.

Always use appropriate safety equipment when applying pesticides. This is especially important in greenhouses, where the enclosed space presents the special dangers of inhaling materials. Use approved respirator equipment when making these applications.

Notes

1. Materials and methods listed here should not be used for food crops, including vegetable starts.
2. Not all pesticides listed for a particular pest are registered on all greenhouse crops. Be certain to check the label regarding your application.
3. This information is presented to assist you in selecting appropriate pest control methods. The pesticide label is the final word on what does or does not constitute a legal application. Due to the wide variety of plants, locations, and conditions under which pesticides are applied, greenhouse plants are particularly susceptible to insecticide injury. Phytotoxic effects that have been observed are noted on the manufacturer's label. To test for phytotoxicity, treat a small number of plants and observe for plant injury. In general, sprays prepared from wettable powder (WP) formulations are less likely to cause injury than those prepared from emulsifiable concentrates (EC), but wettable powder sprays may leave an undesirable residue on some plants.

A few simple greenhouse sanitation practices can decrease the frequency of insecticide application. Weeds under the benches provide food for greenhouse pests and can be a source of reinfestation. Miscellaneous plants that are not part of a crop, but that are kept for long periods, may contribute to greenhouse pest problems. Such plants may harbor insect pests from one crop to the next. Weed growth outside the greenhouse, particularly against the sides of the building, also can be a source of infestation.

Note: Products are listed in alphabetical order and not in order of preference or superiority of pest control.

Greenhouse ornamentals—Aphid

Numerous species

Pest description **and crop damage** Aphids are soft-bodied insects with piercing-sucking mouthparts. They are usually identified by the host plant, and characters such as wing venation, antennae, and cornicles. The same species can vary in color, shape, and size depending on the time of the year. Crop damage includes distorted plant growth, particularly terminals, shiny honeydew, black sooty mold (which can grow on the honeydew), waxy deposits (some species), yellowing, and general plant decline.

Biology and life history There are winged (alate) aphids that can migrate, and wingless adult aphids which remain on the host but can reproduce asexually, producing large aphid populations quickly. Most aphids are associated with one or several host plants. Some have alternate hosts, overwintering on one host and moving to another as the season progresses. Several species, including many common in greenhouses, have a wide host range, with many host plants including weed species. Examples of these species include green peach aphid (*Myzus persicae*), cotton or melon aphid (*Aphis gossipea*), potato aphid (*Macrosiphum euphorbiae),* and cabbage aphid (*Brevicoryne brassacae*).

Scouting and thresholds Scout for aphids near growing terminals and leaf undersides, particularly alongside leaf veins. White cast skins, shiny honeydew, black sooty mold, and misshapen terminals are good indicators of aphid presence. Yellow sticky traps and yellow pan traps can help monitor flights of adults.

Management—biological control

Natural enemies include:

- hoverflies, many species—Maggot-like larvae are voracious predators of aphids. Pollen and nectar-feeding adults are commonly seen around flowers.
- lacewings (*Chrysopa* spp., *Chrysoperla carnea, C. rufilabris, C. comanche*)—Some species commercially available.
- lady beetles (*Hippodamia convergens, Harmonia axyridis, Coleomegilla maculate, Coccinella septempunctata)*—Note: Use of non-local, wild-harvested lady beetles is discouraged due to potential movement of lady beetle pathogens and parasites.
- pirate bugs (*Orius* spp.)—Some species commercially available. Both adults and larvae are predators of small eggs, insects, and mites.
- parasitoid wasps (*Aphidius ervi, A. matricariae, A. colemani, Aphelinus abdominalis, Diaeretiella rapae, Lysiphlebus testaceipes, Trioxys*

pallidus)—Some species commercially available. Many parasitoids have preferred hosts. See specific aphid for more information.

- predatory midge (*Aphidoletes aphidimyza*)—Commercially available and has given good control. Maggot-like larvae are voracious predators of aphids. Adults may go into diapause with low light or short days.

Management—chemical control

Good spray coverage, including the underside of leaves, is important. Aphids excrete honeydew which attracts ants. Ants may need to be controlled by an under-bench treatment before releasing biological control agents.

- abamectin (Avid 0.15EC) at 0.009 lb ai/100 gal (8 fl oz). REI 12 hr. For suppression only.
- acephate (Precise, Orthene TR) at 0.024 lb ai/1,000 sq ft broadcast (0.6 oz). REI 24 hr.
- acetamiprid (Tristar 30SG) at 0.24 lb ai/100 gal (1.3 oz). REI 12 hr.
- afidopyropen (Ventirgra) at 4.0 fl oz with non-ionic spreader/sticker per 100 galazadirachtin (Azahar, Azatin XL)—Insect growth regulator, antifeedant. Some formulations are OMRI-listed for organic use.
- azadirachtin (AZA-Direct Botanical Insecticide, Azaguard)—Unknown/uncertain mode of action. Can be applied aerial, ground or irrigation.
- *Beauvaria bassiana* (Botanigard, Mycotrol, Naturalis L)—Works by contact, good coverage required. Some formulations are OMRI-listed for organic use.
- beta-cyfluthrin (Tempo)—1 to 3 packets per gal water depending on infestation level.
- bifenthrin (Talstar) at 0.084 to 0.168 lb ai/1,000 sq ft. REI 12 hr. Restricted use pesticide.
- bifenthrin/ clothianidin (Aloft)—Liquid and granular ground application or mulch application
- bifenthrin/zeta-cypermethrin/ imidacloprid (Triple Crown Golf Insecticide) 2.5 to 7.5 fl oz per 100 gal; target application to areas where pests are active, use sufficient water to thoroughly wet plant surfaces
- *Burkholderia* spp. (Venerate XC) at 4 to 8 pints per 100 gal.
- canola oil (various RTU products)—Good contact is essential. Some formulations are OMRI-listed for organic use.
- chlorpyrifos (Vulcan) at 1/12 to 1/6 fl oz per gal or 0.5 to 1.0 pint per 100 gal, no more than 2.8 quarts per acre/year
- *Chromobacterium* (Grandevo) at 1 to 3 lb/A depending on specific crop.
- cinnamaldehyde (Seican)—Foliar spray. Maximum rate of 3.5 pints/A.
- cinnamon oil (Cinnerate) at 50 to 210 gal/A
- citric acid (PureAg, Trishield) 1.5-2.0 oz per gallon for infestations, 1.0 oz/gal for maintenance
- clothianidin (Arena 0.25G) at 0.315 to 0.63 oz ai/100 gal. REI 12 hr. Soil treatment refer label.
- clove oil (Nature-cide All-Purpose)
- corn oil (Circadian Sunrise) at 1.0 to 3.0 oz/gal.
- cotton seed oil (Furious) at 22 to 33 fl oz/A or 3 fl oz/gal for 1,000 sq ft. WA only.
- cyantraniliprole (Mainspring GNL) at 0.16 lb ai/100 gal drench. REI 4 hr.
- cyclaniliprole/flonicamid (Pradia) at 10 to 17.5 fl oz/100 gal.
- cyfluthrin (Decathlon 20WP) at 1.9 oz/100 gal. REI 12 hr.
- cyfluthrin/imidacloprid (Discus L) at 0.063 lb ai/100 gal foliar; 0.009 to 0.014 lb ai/1,000 ft soil. REI 12 hr.
- cyhalothrin (Declare, Scion) at 0.0 to 0.0lb/A or 1.0 to 2.06 fl oz/A. Do not apply more than 0.12 lb active ingredient (0.77 pints) per acre per year. Declare is a Restricted Use Pesticide
- cypermethrin (Demon) at 33 oz/100 gal, sprayer output at 1.0 gal per 1,000 sq ft.
- DDVP (nuvan fog 5%) use is prohibited on food plants
- deltamethrin (D-Fense Dust) at 8 oz product per 1,000 sq ft or as a thin layer.
- diatomaceous earth (Perm Guard Garden and Plant)—Application varies between dry and wet application types, refer to label for rates.
- dinotefuran (Safari 20SG) at 0.1 to 0.2 lb ai/1,000 ft sq; 0.05 to 0.1 lb ai/100 gal. REI 12 hr.
- fenpropathrin (Valent Tame 2.4 EC)—Apply as tank mix with Orthene Turf, Tree and Ornamental Spray.
- flonicamid (Aria) at 0.022 to 0.067 lb ai/100 gal. REI 12 hr.
- flupyradifurone (Altus) at 7.0 to 10.5 fl oz/A. REI 4 hr.
- geraniol, rosemary and peppermint oils (Keyplex Ecotrol Plus)—Topical mixed at 20 to 40 fl oz/gal.
- GS-omega/kappa-hxtx-hv1a (Spear T)—Use in high pressure, low volume spray and fogging equipment in greenhouses at 1 to 3 gal per 100 gal water
- imidacloprid (Marathon II) at 0.027 oz ai/100 gal foliar. REI 12 hr. Drench and irrigation permitted.
- *Isaria fumosorosea* (PFR 97) at 0.175 to 3.5 lb ai/100 gal foliar. REI 4 hr.
- kaolin (Surround)—Some formulations are OMRI-listed for organic use. May leave residue.
- lambda-cyhalothrin (Scimitar GC) at 0.013 to 0.043 lb ai/100 gal. REI 24 hr.
- methiocarb (Mesurol 75W) at 0.375 to 0.5 lb ai/100 gal. REI 12 hr. Restricted use pesticide.
- mineral oil/petroleum distillate (Biocover LS)
- naled (Dibrom 8)—Application varies by application type and crop.
- neem oil (Nimbiosys Neem Oil) at 1 to 2 pints/A using a 0.5% concentration; for very heavy pest pressure, use up to 3.5 pints/A in a 1.1% solution
- permethrin (Pounce 25 WP)—Application rates depend on specific host plant.
- piperonyl butoxide (Pyrethrum TR, Evergreen Pro, Pyrenone Crop Spray and others)—Refer to labels for specific application rates.

- potassium laurate (Kopa Insecticidal Soap) 2 gal prod/100 gal water
- pymetrozine (Endeavor) at 1.25 to 2.5 oz ai/100 gal. REI 12 hr.
- pyrethrins (E.B. Stone, Earth-tone, Worryfree)—Good contact essential. Some formulations are OMRI-listed for organic use.
- pyridiben (Sanmite SC) at 6.4 to 9.6 oz/A or 0.15 to 0.22 oz per 1,000 sq ft.
- pyrifluquinazon (Rycar) at 0.034 to 0.045 lb ai/100 gal. REI 12 hr. Limit 2 treatments per crop.
- pyriproxifen (Distance) at 0.041 to 0.054 lb ai/100 gal (6 to 8 fl oz) foliar. REI 12 hr. Suppression.
- s-kinoprene (Enstar AQ) at 0.012 to 0.024 lb ai/10,000 sq ft. REI 4 hr.
- sodium borate (Prev-Am) fungicide + insecticide—Label rates vary by application type
- soybean oil (Golden Pest)—Dilute 1 to 3 gal per 100 gal water.
- spinetoram, sulfoxaflor (XXPire) at 0.06 to 0.08 oz/3 gal or 2.0 to 2.75 oz/100 gal.
- spirotetramat (Kontos) at 0.027 to 0.053 lb ai/100 gal. REI 24 hr.
- tau-fluvalinate (Mavrik Aquaflow) at 0.063 to 0.156 lb ai/100 gal. REI 12 hr.
- thiamethoxam (Flagship 25WG) as fogger—REI 12 or 24 hr.
- tolfenpyrad (Hachi-Hachi) at 0.14 to 0.33 lb ai/100 gal. REI 12 hr.

Greenhouse ornamentals—Fungus gnat

Includes
Bradysia coprophila
Bradysia impatiens
Bradysia paupera

Pest description and crop damage Larvae are small white, legless maggots with black head capsules. Adult midges are delicate, black-bodied insects with long legs and antennae. Their wings have a y-shaped vein along its edge distinguishing them from shore flies which are stout-bodied with short antennae and five white spots on their dark wings. The maggots can feed on decaying organic matter as well as plant roots. Larval feeding causes damage to seedling roots and high populations can kill young plants. Both larvae and adults can move spores of plant pathogens.

Biology and life history Eggs are laid in the container substrate or greenhouse floor. The tiny eggs hatch in 4 to 6 days, larvae feed for another 2 to 14 days, then pupate in the substrate or ground for another 5 to 6 days before emerging as an adult. Adults can live a week to 10 days. There are multiple generations per year. Higher populations are associated with wet, low drainage areas of production. Increasing drainage and maintaining a moss and algae free production area will reduce conducive conditions.

Scouting and thresholds Scouting for fungus gnats is usually done with yellow sticky cards. This will give one an indication of the numbers of adult fungus gnats. Some people place potato slices on the soil or medium to monitor for the larvae. Check roots of puny-looking plants for signs of the larvae.

Management—biological control (larvae)

Natural enemies include:

- parasitic nematode (*Steinernema feltiae*)— Commercially available. Applied as a drench to substrate. Generally will need to be applied more than once.
- predatory mite (*Stratiolaelaps*)—Commercially available.
- rove beetle (*Atheta coriaria*)—Commercially available.
- soil-dwelling mite (*Hypoaspis miles*)— Applied to substrate.

Management—chemical control

Use yellow sticky traps to assess infestation and control efforts. Often, fungus gnats are a serious pest in propagation facilities, where larvae damage young roots. Infestations are associated with a highly organic potting mix. Much of the management is directed at controlling the larval stages in the media and floor. Adult control is generally less effective in controlling populations.

- acephate (Orthene TR) at 0.024 lb ai/1,000 sq ft broadcast (0.6 oz). REI 24 hr.
- acetamiprid (Tristar 30SG) at 0.5 lb ai/100 gal (2.7 oz). REI 12 hr.
- azadirachtin (Azahar, Azatin XL)—Insect growth regulator.
- *Bacillus thuringiensis israelensis* (*Bti*) (Gnatrol) as a drench to the substrate to kill larvae. Use a *Bt* formulation specifically designed for fungus gnats. Generally will need to be applied more than once. Some formulations are OMRI-listed for organic use.
- *Beauveria bassania* (Xpectro OD) up to 2 quarts per 100 gal spray volume.
- beta-cyfluthrin (Tempo Ultra GC) at 45 to 160 ml/100 gal water.
- bifenthrin (Talstar) at 0.168 to 0.335 lb ai/1,000 sq ft. REI 12 hr. REI 12 hr. Restricted use pesticide.
- canola oil, pyrethrins (Pycana)—Use a 1% solution for soft-bodied insects.
- chlorfenapyr (Pylon) at 0.08 to 0.16 lb ai/100 gal. REI 12 hr.
- chlorpyrifos (Duraguard)—For heavy infestation use 0.5 fl oz per gal water, spray all foliage uniformly.
- cinnamaldehyde (Seican)—Rates differ for appearance and pest pressure.
- cotton seed oil, geraniol, rosemary oil, peppermint oil (Furious) at 22 to 33 fl oz/A or 3 fl oz./gal for 1,000 sq ft. WA only.
- cyfluthrin (Decathlon) at 1.3 oz/100 gal. REI 12 hr.
- cyfluthrin/imidacloprid (Discus N/G) at 0.063 lb ai/100 gal foliar; 0.009 to 0.014 lb ai/1,000 ft soil. REI 12 hr.

- cyromazine (Citation) at 2 oz ai/100 gal. REI 12 hr. Apply to the larval stage.
- deltamethrin (Annihilator Polyzone) at 0.25 to 1.5 fl oz per 1,000 sq ft of surfaces.
- diflubenzuron (Adept) at 0.5 oz ai/100 gal soil. REI 12 hr. Apply to the larval stage.
- dinotefuan (Safari 20SG) at 0.1 to 0.2 lb ai/1,000 ft sq; 0.05 to 0.1 lb ai/100 gal. REI 12 hr.
- esfenvalerate, piperonyl butoxide (Onslaught Fastcap) at 0.5 to 1.0 fl oz/gal depending on infestation, apply as wet coarse spray.
- geraniol, rosemary and peppermint oils (Keyplex Ecotrol Plus) Keyplex Ecotrol Plus)—Topical mixed at 20 to 40 fl oz/gal.
- imidacloprid (Marathon II) at 0.027 oz ai /100 gal foliar. REI 12 hr. Drench and irrigation permitted.
- *Isaria fumosorosea* (No-Fly WP) for greenhouse and indoor use only
- mineral oil/petroleum distillate (Biocover LS)—Some formulations are OMRI-listed for organic use.
- neem oil (Debug ON) at 2 to 10 fl oz in 2 or 3 gal water, use for 1,000 sq ft; more effective as preventative.
- permethrin (Tengard, Agrisel Zone-Plus)—Rates vary by product.
- pyrethrins (Lynx EC 1.4, Pyganic) at 16 to 32 oz with 30 gal water in conventional hydraulic sprayer.
- permethrin, piperonyl butoxide (Drop Dead)—Spray at a distance of 12 to 15 inches
- pyrethrins/piperonyl butoxide—Adult control.
- pyriproxyfen (Distance) at 0.054 to 0.081 lb ai/100 gal (8 to 12 fl oz) foliar. REI 12 hr.
- s-kinoprene (Enstar AQ) at 0.012 to 0.024 lb ai/10,000 sq ft. REI 4 hr.
- soybean oil (Golden Pest Spray)—Some formulations are OMRI-listed for organic use.
- thiamethoxam (Flagship 25WG)—Separate application rate recommendations depend on application type.

Greenhouse ornamentals—Leafminer

Liriomyza trifolii

Pest description and crop damage Leafminer adults are small flies, the most common is Liriomyza trifolii, which is about 0.125 inches long and black and yellow. The larvae are legless maggots. Mines from larval feeding in the leaves can make plants unmarketable.

Biology and life history The adult leafminer inserts its eggs into the leaf material. The egg hatches and the small white maggot mines within the leaves. The maggots then drop to the floor or substrate to pupate. Leafminers can complete a generation in about two weeks at 95°F. There can be many life cycles per season.

Scouting and thresholds Leafminers can be monitored with yellow sticky cards and looking for direct sting or oviposition damage on the leaves.

Management—biological control

Natural enemies include:

- entomopathogenic nematodes (*Steinernema feltiae*)—Foliar applications in greenhouses
- parasitic wasps (*Dacnusa sibirica*)—Commercially available. Used for management of *Liriomyza* spp.
- parasitic wasps (*Diglyphus* spp.)—Commercially available. Used for management of *Liriomyza* spp.

Management—chemical control

- abamectin (Avid 0.15 EC) at 0.009 lb ai/100 gal (8 fl oz). REI 12 hr. Apply at 7-day intervals.
- acephate (Precise, Orthene TR) at 0.024 lb ai/1,000 sq ft broadcast (0.6 oz). REI 24 hr.
- acetamiprid (Tristar 30SG) at 0.5 lb ai/100 gal (2.7 oz). REI 12 hr.
- azadiractin (Azahar, Azatin XL)—Insect growth regulator. Some formulations are OMRI-listed for organic use.
- bifenthrin (Talstar) at 0.335 to 0.67 lb ai/1,000 sq ft. REI 12 hr. Restricted use pesticide.
- bifenthrin, clothianidin (Aloft)—Various formulations, some RUP.
- canola oil, pyrethrins (Pycana)—Dormant, pre-bloom and summer use 1% = 1.5 to 3 gal/1,000 sq ft; 2% = 1.5 gal/100 sq ft.
- carbaryl (Sevin) at 1 quart/A or per 100 gal (3/4 fl oz per 1,000 sq ft).
- chlorantraniliprole (Acelepryn) foliar, bark and soil treatment
- chlorpyrifos (Vulcan) at 1/12 to 1/6 fl oz per gal on 0.5 to 1 pint per 100 gal, no more than 2.8 quarts per acre/year.
- clothianidin (Arena)—Post bloom applications only, 2 to 3 oz/100 gal spray solution or 4 to 6 oz/A.
- cottonseed oil (Furious) at 22 to 33 fl oz/A or 3 fl oz/gal for 1,000 sq ft. WA only.
- cyantraniliprole (Mainspring) at 2 to 8 fl oz per 100 gal (0.6 to 2.4 ml per gal). Reapply on a 7- 14-day interval.
- cyclaniliprole (Sarisa) at 16.4 to 27 fl oz (0.054 to 0.090 lb. ai/100 gal) or 16.4 to 27 fl oz (0.054 to 0.090 lb. ai/A)
- cyclaniliprole/flonicamid (Pradia) at 10 to 17.5 fl oz/100 gal.
- cyfluthrin/imidacloprid (Discus N/G) at 0.063 lb ai/100 gal foliar; 0.009 to 0.014 lb ai/1,000 ft soil. REI 12 hr.
- cyhalothrin-gamma (Scion) at 1.3 to 4.4 fl oz/100 gal or 39 to 132 mL/100 gal.
- cyromazine (Citation) at 2 oz ai/100 gal. Apply to the larval stage. REI 12 hr.
- deltamethrin (D-Fense Dust) at 8 oz product per 1,000 sq ft or as a thin layer.
- diazinon (Diazinon 50W) at 1.0 lb/100 gal water; spray when first appear.
- diflubenzuron (Adept) at 0.5 oz ai/100 gal soil. Apply to the larval stage. REI 12 hr.
- dimethoate (Dimate 4E)—Rate specific to host species.
- dinotefuran (Safari 20SG) at 0.1 to 0.2 lb ai/1,000 ft sq; 0.05 to 0.1 lb ai/100 gal. REI 12 hr.

- emamectin benzoate (TREE-age)—Application rate dependent on DBH.
- fenpropathrin (Tame 2.4EC) at 0.1 to 0.2 lb ai/A (5.3 to 10.7 fl oz). REI 24 hr.
- flupyradifurone (Altus) (citrus leafminer suppression) at 14.0 fl oz/A.
- geraniol, peppermint oil, rosemary oil (Keyplex Ecotrol) at 16 to 48 fl oz/100 gal; spray at first appearance, every 5–7 days
- imidacloprid (Marathon II) at 0.027 oz ai /100 gal foliar. Drench and irrigation are permitted. REI 12 hr.
- *Isaria fumosoroseus* (PFR 97) at 0.175 to 3.5 lb ai/100 gal foliar. REI 4 hr.
- lambda-cyhalothrin (Scimitar GC) at 0.013 to 0.043 lb ai /100 gal. REI 24 hr. Adult leafminers only.
- malathion (Malathion 8 Aquamul) at 1.25 pints in 100 gal water as a dilute spray.
- methoxyfenozide (Invertid, Intrepid 2F, Inspirato 2F and others)—Application varies by product, see label for application rates.
- mineral oil/petroleum distillate (Biocover LS)—Some formulations are OMRI-listed for organic use.
- naled (Dibrom 8)—Application varies by application type and crop.
- neem oil (Nimbiosys) at 1 to 2 pints/A at 0.5% concentration of neem oil in water.
- novaluron (Pedestal) at 0.039 to 0.052 oz ai/100 gal. Apply to the larval stage. REI 12 hr.
- permethrin (Pounce 25 WP) at 6.4 to 12.8 oz (0.1 to 0.2 lb active) per 100 gal water.
- permethrin, piperonyl butoxide (Drop Dead)—Spray at a distance of 12 to 15 inches
- phosmet (Imidan) at 0.75 to 1 lb per 100 gal. (0.5 to 0.7 lb ai).
- phosphine (Eco2Fume Fumigant Gas)—RUP between 0°C and 25° C. Minimum of 200 ppm/0.88 lb of product to 3,625 ppm or 16.0 lb. Do not fumigate at max rate.
- piperonyl butoxide, pyrethrins (Stryker, Pyrenone Crop Spray, Pyronyl Crop Spray)—Various application rates.
- potassium laurate (M-Pede)—Use a 1 to 2% solution
- pyrethrins (Tersus) flower and foliage plants at 13.07 fl oz concentrate with 100 gal water, apply at 3 gal/1,000 sq ft.
- pyriproxifen (Distance) at 0.054 to 0.081 lb ai/100 gal (8 to 12 fl oz) foliar. Apply to the larval stage. REI 12 hr.
- s-kinoprene (Enstar AQ) at 0.012 to 0.024 lb ai/10,000 sq ft. REI 4 hr.
- sodium borate (Prev-Am) fungicide + insecticide—Label rates vary by application type
- soybean oil (Golden Pest)—Dilute 1 to 3 gal per 100 gal water.
- thiamethoxam (Flagship 25W)—Separate application rate recommendations depend on application type.

Greenhouse ornamentals—Mealybug

Includes
Citrus mealybug (*Planoccoccus citri*)
Longtailed mealybug (*Pseudococcus longispinus*)

Pest description and crop damage Like other soft-bodied, piercing mouthpart insects, mealybugs suck plant juices, cause tissue distortion, and plant decline, and secrete honeydew copiously. Keys are commercially available to distinguish species of mealybugs, scales, and whiteflies. Citrus mealybug, *Planoccoccus citri*, is a common pest in such situations. The longtailed mealybug, *Pseudococcus longispinus* is another familiar species in protected systems distinguished by two long waxy filaments forming a 'tail'.

Biology and life history Adult mealybugs lay their eggs generally in an ovisac or egg sack often near a stem juncture or under thick stipules. The ovisac is made out of a white, waxy secretion and may be filled with several hundred eggs. Once the eggs hatch, the tiny nymphs move around the plant where they feed. Adult female mealybugs resemble the nymphs, though larger, but the males look like small white-colored flies and are uncommonly seen.

Scouting and thresholds Scout for the white egg sacs near stem nodes and branch connections. Some species of mealybugs spend time as a root infesting aphid, so new plant acquisitions should be inspected for infestations above and below the plant surface.

Management—biological control

Natural enemies include:
- lady beetle, *Cryptolaemus montrouszieri,* "mealybug destroyer"
- predatory wasp, *Leptomastix* (for citrus mealybugs), *Pseydaphycus angelicus* (for longtailed mealybug),

Management—chemical control

Mealybug and scale pests are best controlled at the "crawler" stage: the immature, active stage when the insects are most sensitive to insecticides.
- acephate (Precise, Orthene TR) at 0.024 lb ai/1,000 sq ft broadcast (0.6 oz). REI 24 hr.
- acetamiprid (Tristar 30SG) at 0.5 lb ai/100 gal (2.7 oz). REI 12 hr.
- afidopyropen (Ventigra) at 4.8 to 7.0 fl oz/100 gal.
- azadiractin (Azahar, Azatin XL)—Some formulations are OMRI-listed for organic use.
- *Beauvaria bassiana* (Botanigard, Mycotrol, Naturalis L)—Some formulations are OMRI-listed for organic use.
- beta-cyfluthrin (Tempo Ultra) at 45 to 160 ml (1.5 to 5.4 fl oz) per 100 gal water.
- bifenthrin (Talstar P) at 0.168 to 0.335 lb ai/1,000 sq ft. REI 12 hr. Restricted use pesticide.
- bifenthrin, clothianidin (ALOFT) —Liquid and granular ground application or mulch application.
- bifenthrin, imidacloprid (Triple crown gold insecticide) at 2.5 to 7.5 fl oz per 100 gal; target application to areas where pests are active, use

sufficient water to thoroughly wet plant surfaces.

- bifenthrin, zeta-cypermethrin (TalstarXTRA granular) at 0.125 to 0.25 lb ai/A.
- boscalid (Bonide Fruit Tree and Plant Guard)—Mix 2 fl oz/gal of water and apply as a foliar cover spray.
- buprofezin (Talus 70DF) at 0.75 lb ai/A. REI 12 hr. Works on immature stage.
- *Burkholderia* spp. (Venerate CG)—OMRI-listed for organic use.
- canola oil, capsaicin, garlic oil/powder (Captiva Prime)—Dilute 1 to 2 pints per acre; apply every 4 to 7 days.
- canola oil, pyrethrins (Pycana)—Dormant, pre-bloom and summer use 1% = 1.5 to 3 gal/1,000 sq ft; 2% = 1.5 gal/1,000 sq ft.
- capsaicin, garlic oil (Captiva) at 4 pints/A.
- carbaryl (Drexel) at 1 quart per acre or per 100 gal (0.75 fl oz per 1,000 sq ft).
- chlorpyrifos (Vulcan) at 1/12 to 1/6 fl oz per gal on 0.5 to 1 pint per 100 gal, no more than 2.8 quarts per acre/year.
- *Chromobacterium* (Grandevo)—Application rates based on host plant.
- cinnamaldehyde (Seican)—Variable rates for the first appearance, common and high pressure.
- cinnamon oil (Cinnerate) at 13 to 64 fl oz/100 gal, 50 to 210 gal/100 gal waterclothianidin (Arena) at 0.5 to 1.0 lb/ft of height (5 to 10 lb per 10 ft of height). Trees 0.5 to 1.0 lb/inch of trunk diameter of breast height (DBH); only apply to moist soil media.
- corn oil/peppermint oil (Circadian Sunrise) at 1 to 3 oz/gal; 1-day spray interval permissible in greenhouse only.
- cottonseed oil, peppermint oil, geraniol, rosemary oil (Furious) at 22 to 33 fl oz/A or 3 fl oz/gal for 1,000 sq ft. WA only.
- cyclaniliprole/flonicamid (Pradia) at 10 to 17.5 fl oz/100 gal.
- cyfluthrin (Decathlon) at 1.9 oz/100 gal. REI 12 hr.
- cyfluthrin/imidacloprid (Discus L) at 0.063 lb ai/100 gal foliar; 0.009 to 0.014 lb ai/1,000 ft soil. REI 12 hr.
- cyhalothrin (Declare) max rate at 0.12 lb ai/A.
- DDVP (nuvan fog 5%)—Use is prohibited on food plants
- deltamethrin (Deltaguard) at 2 to 3 lb/1,000 sq ft or 0.08 to 0.13 lb ai/A.
- diazinon (Diazinon 50W) at 1 lb/100 gal water; spray when first appear.
- dimethoate (Dimate 4E)—Rate specific to host species.
- dinotefuran (Safari 20SG) at 0.1 to 0.2 lb ai/1,000 ft sq; 0.05 to 0.1 lb ai/100 gal. REI 12 hr.
- esfenvalerate (Onslaught)—Apply full coverage foliar spray once every 7 days.
- fenpropathrin (Tame 2.4EC) at 0.3 lb ai/A (16 fl oz). REI 24 hr.
- fenproximate (Akari 5SC) at 0.079 lb ai/100 gal. REI 12 hr.
- flonicamid (Aria) at 0.067 to 0.134 lb ai/100 gal. REI 12 hr.
- flupyradifurone (Altus) at 10.5 to 14 fl oz/A. REI 4 hr.
- geraniol, peppermint oil, rosemary oil (Keyplex Ecotrol) at 16 to 48 fl oz/100 gal; spray at first appearance, every 5-7 days.
- imidacloprid (Marathon II) at 0.027 oz ai /100 gal foliar. REI 12 hr. Drench and irrigation permitted.
- *Isaria fumosoroseus* (PFR 97) at 0.175 to 3.5 lb ai/100 gal foliar. REI 4 hr.
- lambda-cyhalothrin (Scimitar GC) at 0.013 to 0.043 lb ai/100 gal. REI 24 hr.
- malathion (Malathion 8 Aquamul) at 1 pint in 100 gal of water as a dilute spray.
- mineral oil/petroleum distillate (Biocover LS)—Some formulations are OMRI-listed for organic use.
- naled (Dibrom 8)—Application varies by application type and crop
- neem oil (Debug ON)—Mix 2 to 10 fl oz per 2 or 3 gal water; can be used as a preventative. OMRI-listed for organic use.
- permethrin (Bonide Eight)—Mix 1 fl oz in 1 gal water.
- phosmet (Imidan) at 0.75 to 1 lb per 100 gal. (0.5 to 0.7 lb ai).
- phosphine (Eco2Fume Fumigant Gas)—RUP between 0°C and 25°C. Minimum of 200 ppm/0.88 lb of product to 3,625 ppm or 16.0 lb. Do not fumigate at max rate.
- piperonyl butoxide, pyrethrins (Stryker, Pyrenone Crop Spray, Pyronyl Crop Spray)—Various application rates.
- potassium laurate (several labels)—Some formulations are OMRI-listed for organic use.
- pyrethrins (several)—Applications vary by label.
- pyrifluquinazon (Rycar) at 0.09 lb ai/100 gal. REI 12 hr. Limit 2 treatments per crop.
- pyriproxyfen (Distance) at 0.054 to 0.081 lb ai/100 gal (8 to 12 fl oz) foliar. REI 12 hr. Works on immature stages.
- s-kinoprene (Enstar AQ) at 0.012 to 0.024 lb ai/10,000 sq ft. REI 4 hr.
- soybean oil (Golden Pest Spray)—Some formulations are OMRI-listed for organic use.
- spinetoram (XXPire) at 4 to 5.5 oz/A (0.05 to 0.069 lb ai/A).
- spirotetramat (Kontos) at 0.027 to 0.053 lb ai/100 gal. REI 24 hr. Systemic activity.
- tau-fluvalinate (Mavrik Aquaflow) at 0.063 to 0.156 lb ai/100 gal. REI 12 hr.
- thiamethoxam (Flagship 25WG) as fogger. REI 12 or 24 hr.
- tolfenpyrad (Hachi-Hachi) at 14 to 32 fl oz/100 gal. REI 12 hr.

Greenhouse ornamentals—Scale

Numerous species

Pest description and crop There are two types of scale insects commonly encountered in greenhouses: hard scale and soft scale. Hard scale insects tend to be fairly small in size and lie flatter against the stems than do soft scale insects. Soft scale insects are often very rounded and will also produce honeydew with their associated black sooty mold. Scale insects may have only one or multiple generations per year. Scale insects often come into a greenhouse on propagation material. This example shows the importance of inspections and, sometimes, quarantine any new plant material brought into the greenhouse. Early infestations can often be rogued or pruned out.

Biology and life history Most scale insects are female. Mature females are wingless and often secrete a hard shell-like covering for protection. The males are rare, small, non-feeding, and short-lived but look more like other insects as they have wings. With a few notable exceptions, the first immature stage, or the first "instar" females, are generally the only stage that disperses on plant material. All other stages remain attached to the plant surface, sessile. Females lay eggs or crawlers under their secreted scale covering or in a cavity under their bodies.

Scouting and thresholds Look for scale insects along stems and leaf undersides. Double-sided sticky tape can be used to check for emerging scale crawlers.

Management—biological control

Check for the presence of holes in the scale covers indicating parasitic wasp activity.

Natural enemies include:

- lady beetles, *Chilocorus* spp.
- *Rhizobius*—A soft scale predator.

Management—chemical control

Mealybug and scale pests are best controlled at the "crawler" stage: the immature, active stage when the insects are most sensitive to insecticides. Spray applications should be timed to coincide with the emergence of vulnerable crawlers. Ants, fond of honeydew, will fight off scale natural enemies to protect the source.

- acephate (Orthene TR) at 0.024 lb ai/1,000 sq ft broadcast (0.6 oz). REI 24 hr.
- acetamiprid (Tristar 30SG) at 0.5 to 0.1 lb ai/100 gal (2.7 to 5.3 oz). REI 12 hr.
- afidopyropen (Ventigra) at 4.8 to 7.0 fl oz per 100 gal.
- azadiractin (Azahar)—Some formulations are OMRI-listed for organic use.
- beta-cyfluthrin (Tempo Ultra GC) at 45 to 160 mL (1.5 to 5.4 fl oz) per 100 gal water.
- bifenthrin (Talstar) at 0.168 to 0.335 lb ai/1,000 sq ft. REI 12 hr. Restricted use pesticide.
- buprofezin (Talus 70DF) at 0.88 lb ai/A. REI 12 hr.
- *Burkholderia* spp. (Venerate)—OMRI-listed
- canola oil/pyrethrin --Some formulations are OMRI-listed for organic use.
- carbaryl (Sevin SL) at 1 quart per acre or per 100 gal (0.75 fl oz per 1,000 sq ft).
- chlorpyrifos (Vulcan) at 1/12 to 1/6 fl oz per gal on 0.5 to 1 pint per 100 gal, no more than 2.8 quarts per acre/year.
- *Chromobacterium* (Grandevo)—Rates based on host plant.
- cinnamaldehyde (Seican)—Variable rates for the first appearance, common and high pressure.
- cinnamon oil (Cinnerate) at 13 to 64 fl oz/100 gal, 50 to 210 gal/A.
- clothianidin (Arena 0.25G) at 1 to 1.5 oz ai/100 gal. REI 12 hr. Soft scale.
- cottonseed oil, peppermint oil, geraniol, rosemary oil (Furious) at 22 to 33 fl oz/A or 3 fl oz/gal for 1,000 sq ft. WA only.
- cyantraniliprole (Mainspring GNL) at 0.013 to 0.1 lb ai/100 gal. REI 4 hr.
- cyantraniliprole (Mainspring) at 2 to 8 fl oz per 100 gal (0.6 to 2.4 ml per gal). Reapply on a 7- to 14-day interval.
- cyclaniliprole (Sarisa) at 16.4 to 27 fl oz/100 gal.
- cyfluthrin (Decathlon 20WP) at 1.9 oz/100 gal. REI 12 hr.
- cyfluthrin/imidacloprid (Discus L) at 0.063 lb ai/100 gal foliar; 0.009 to 0.014 lb ai/1,000 ft soil. REI 12 hr.
- cyhalothrin (Scion) at 1.3 to 4.4 fl oz per 100 gal –or– 39-132 ml per 100 gal
- deltamethrin (D-Fense SC)—Apply as a coarse spray at 0.25 to 1.5 fl oz for 1,000 sq ft.
- diazinon (Diazinon AG600 WBC) at 0.5 fl oz per 3 gal or 12.75 fl oz per 100 gal water.
- dimethoate (Dimethoate 400)—Variable application based on host plant.
- dinotefuran (Safari 20SG) at 0.1 to 0.2 lb ai/1,000 ft sq; 0.05 to 0.1 lb ai/100 gal. REI 12 hr.
- emamectin (TREE-age) target scale on buds and leaf—Rate based on DBH.
- fenpropathrin (Valent Tame 2)—For San Jose scale crawlers. Must mix with Tame 2.4 EC.
- flonicamid (Aria) at 0.067 to 0.134 lb ai/100 gal. REI 12 hr.
- flupyradifurone (Altus) at 10.5 to 14 fl oz/A. REI 4 hr.
- geraniol, peppermint and rosemary oil (Keyplex Ecotrol) at 16 to 48 fl oz/100 gal; spray at first appearance, every 5-7 days.
- imidacloprid (Marathon II) at 0.027 oz ai /100 gal foliar. REI 12 hr. Drench and irrigation permitted.
- lambda-cyhalothrin (Scimitar GC) at 0.023 to 0.043 lb ai /100 gal. REI 24 hr.

- lime sulfur (Sulforix) for use on roses only, nursery stock and field grown ornamental
- malathion (malathion 8)—Rate based on scale species and host plant mineral oil/petroleum distillate (Biocover LS).
- mineral oil, petroleum distillate (Wil-Gro) at 1 to 2 gal per 100 gal water.
- naled (Dibrom 8)—Application varies by application type and crop
- neem (Nimbiosys) at 1 to 2 pints/A at 0.5% concentration.
- phosphine (Eco2Fume) fumigant
- piperonyl butoxide, pyrethrins (Stryker, Pyrenone Crop Spray, Pyronyl Crop Spray)—Various application rates.
- potassium laurate (several labels)—Some formulations are OMRI-listed for organic use.
- pyrethrins (Lynx EC 1.4) at 16 to 64 fl oz per acre in sufficient water for even coverage, minimum 5 gal.
- pyriproxifen (Distance) at 0.054 to 0.081 lb ai/100 gal (8 to 12 fl oz) foliar. REI 12 hr.
- s-kinoprene (Enstar AQ) at 0.012 to 0.024 lb ai/10,000 sq ft. REI 4 hr. soft scale.
- sodium borate (Prev-Am) fungicide + insecticide—Rates vary by application type
- soybean oil (Golden Pest Spray)—Some formulations are OMRI-listed for organic use.
- spinetoram (XXPire) at 7.0 oz /A (0.088 lb ai/A)
- spirotetramat (Konotos) at 0.027 to 0.053 lb ai /100 gal. REI 24 hr. For crawlers.
- thiamethoxam (Flagship 25W) at 4 to 8.5 oz/100 gal or 8 to 17 oz/A.
- tolfenpyrad (Hachi-Hachi) at 0.14 to 0.33 lb ai/100 gal. REI 12 hr.

Greenhouse ornamentals—Spider mite

Including

Twospotted spider mite (*Tetranychus urticae*)

Pest description and crop damage Several species of spider mites can cause damage in deciduous ornamentals. The appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish-brown, depending on the species. Mites damage plants by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor.

Biology and life history Most mite species share a similar life cycle. The majority of twospotted mites overwinter as adult females. Mites become active in the spring. There may be eight to ten overlapping generations per year.

Scouting and thresholds Observe the leaves for mites and webbing and check for the number of pest and predator mites.

Management—biological control

Natural enemies include:

- minute pirate bugs, *Orius* spp.
- predatory lady beetle, *Stetorus* spp.
- predatory midge, *Felitiella*
- predatory mites, *Neoseiulus californicus*, *N. fallacies*, *Amblyseius hibisci*, *Phytoseiulus persimilis*, *P. macrophililis*, *P. longipes* (*Metaseiulus*), *Galendromus occidentalis*

Management—chemical control

- abamectin (Avid 0.15 EC) at 0.005 lb ai/100 gal (4 fl oz). REI 12 hr.
- acephate (Precise, Orthene TR) at 0.024 lb ai/1,000 sq ft broadcast (0.6 oz). REI 24 hr.
- acequinocyl (Shuttle O) at 6.4 to 12.8 fl oz/A. REI 12 hr.
- acetamiprid (Transport) perimeter treatment applications.
- azadirachtin (Azamax) at 5 fl oz/10 gal water every 10 to14 days.
- *Beauveria bassiana* (Mycotrol ESO)—3 quarts/100 gal water, spray to wet but avoid a runoff.
- bifenazate (Floramite SC) at 0.625 to 0.125 lb ai/100 gal. REI 12 hr.
- bifenthrin (Talstar) at 0.168 to 0.335 lb ai/1,000 sq ft. REI 12 hr. Restricted use pesticide.
- *Burkholderia* spp. (Venerate XC) at 2 to 4 quarts per 100 gal.
- canola oil (Mighty)—Do not apply more than 2.5 gal/100 sq ft. Do not reapply within 3 days.
- capsaicin (General Hydroponics) at 0.5 to 1 tsp per gal over 350 sq ft.
- chlorfenapyr (Pylon) at 0.04 to 0.08 lb ai/100 gal. REI 12 hr.
- chlorpyrifos (Vulcan) at 1/12 to 1/6 fl oz per gal on 0.5 to 1 pint per 100 gal, no more than 2.8 quarts per acre/year.
- *Chromobacterium* (Grandevo)—Rates based on host plant.
- cinnamaldehyde (Seican)—Variable rates for first appearance, common and high pressure.
- citronellol (BioMite) at 1 to 2 quarts/100 gal, 100 to 400 gal/A. OMRI-listed for organic use.
- clofentezine (Ovation SC) at 0.0625 lb ai/100 gal. REI 12 hr.
- corn oil (Circadian Sunrise) at 1 to 3 oz/gal. Agitate solution throughout the application.
- cottonseed oil, peppermint oil, geraniol, rosemary oil (Furious) at 22 to 33 fl oz/A or 3 fl oz/gal for 1,000 sq ft. WA only.
- cyflumetofen (Sultan) at 0.18 lb ai/100 gal. REI 12 hr. Limit 2 treatments.

- cyhalothrin (Declare)—Specific hosts differ in application rates.
- DDVP (nuvan fog 5%) use is prohibited on food plants
- deltamethrin (Suspend SC)—Suppression only; 4 to 8 fl oz/100 gal water.
- diazinon (Diazinon AG600) at 0.5 fl oz per 3 gal or 12.75 fl oz per 100 gal water.
- dimethoate (Dimethoate 400)—Depends on the host plant.
- etoxazole (Tetrasan 5WDG Miticide) at 0.4 to 0.8 oz ai/100 gal. REI 12 hr.
- fenbutatin-oxide (Vendex 50W) at 4 to 8 oz ai/100 gal. REI 48 hr. Restricted use pesticide.
- fenbutatin (Meraz, Vendex)—Follow label rates for application.
- fenpropathrin (Tame 2.4EC) at 0.15 to 0.3 lb ai/A (8 to 16 fl oz). REI 24 hr.
- fenproximate (Akari 5SC) at 0.053 to 0.079 lb ai/100 gal. REI 12 hr.
- geraniol (Ecotec Plus) at 1 to 4 fl oz/100 gal. OMRI-listed for organic use. REI 0 hr.
- gs-omega/kappa-Hxtx-Hv1a (Spear T Liquid)—Application varies by application type.
- hexythiazox (Hexygon DF) at 0.5 to 1 oz ai/100 gal. REI 12 hr.
- *Isaria fumosoroseus* (PRF 97) at 0.175 to 3.5 lb ai/100 gal foliar. REI 4 hr. Some formulations are OMRI-listed for organic use.
- lambda-cyhalothrin (Scimitar GC) at 0.023 to 0.043 lb ai/100 gal. REI 24 hr.
- malathion (Malathion 8 Aquamul) 1.0 pint in 100 gal water as a dilute spray.
- methyl bromide (Meth-o-Gas)
- mineral oil/petroleum distillate (Biocover LS)
- naled (Dibrom 8)—Application varies by application type and crop
- neem oil (Nimbiosys) 1 to 2 pints/A at 0.5% concentration.
- permethrin (ProZap)—Requires heavy contact.
- phosphorous acid (Mite-Phite) foliar 1 to 3 quarts in a minimum of 20 gal water/A.
- potassium laurate (numerous labels)—Some formulations are OMRI-listed for organic use.
- potassium silicate (Sil-Matrix) for organic production—Use 1 quart per 100 gal for a 0.25 solution
- propargite (OMITE-30WS)—Rates vary by host plant.
- propyleneglycol monolaurate (Acaritouch)
- pyrethrin/piperonyl butoxide
- pyridaben (Sanmite) at 3 to 4.5 oz ai/100 gal. REI 12 hr.
- rosemary oil (Tetracurb) 0.25% is preventative, 0.5% for moderate infestation, 1.0% for heavy infestation
- soybean oil (Golden Pest Spray Oil)—Some formulations are OMRI-listed for organic use.
- spinetoram (XXpire) at 3.5 oz/100 gal; 7 oz/A.
- spinosad (Entrust) at 0.047 to 0.156 lb ai/100 gal. OMRI-listed for organic use.
- spiromesifen (Judo) at 0.032 to 0.125 lb ai/100 gal. REI 12 hr.
- spirotetramat (Kontos) at 0.027 to 0.053 lb ai /100 gal. REI 24 hr.
- sulfur (Drexel Suffa) at 2 to 10 pints of this product in 100 gallons of water by ground application or 2 to 20 pints by air
- tau-fluvalinate (Mavrik Aquaflow) at 0.063 to 0.156 lb ai/100 gal. REI 12 hr.

Greenhouse ornamentals—Thrips

Greenhouse thrips (*Heliothrips haemorrhoidalis*)

Pest description and crop damage The insects are very small with fringed wings. Monitoring is usually made by visual inspection for the thrips or their damage. Their damage is usually evident as the scraping of the epidermal layers of the plant leaf. Thrips are vectors of a serious disease. Tomato Spotted Wilt Virus (TMSV) and Impatiens Necrotic Wilt Virus (INSV) can have devastating consequences in susceptible crops.

Biology and life history They tend to prefer very tight spaces and are particularly attracted to flowers with pollen.

Scouting and thresholds Thrips can be very difficult insects to detect. Use blue or yellow sticky traps to assess infestation and control efforts. An aggregation pheromone for thrips, Thripline-AMS, is available for monitoring.

Management—biological control

When there is potential for vectoring disease and/or low tolerance for direct damage from thrips, biological control may be inappropriate as a tactic. There must be some tolerance for a pest to sustain biological control organisms. Where viruses are not a factor or damage tolerance higher, biological control may provide several benefits, including pesticide resistance management, improved worker safety, and reduced re-entry intervals.

Management—biological control

Natural enemies include:

- minute pirate bug, *Orius insidiosus*
- predatory mites, *Typhlodromips* (*Amblyseius*) *swirskii*; *Iphesius degenerans*; *Neoseiulus* (*Amblyseius*) *cucumeris*; *Neoseiulus barkeri*
- predatory thrips, *Thripobius semiluteus*
- soil-dwelling predatory mite, *Hypoaspis miles*—Feeds on pupal stage in soil.

Management—chemical control

- abamectin (Avid 0.15EC) at 0.009 lb ai/100 gal (8 fl oz). REI 12 hr. Suppression.
- acephate (Precise, Orthene TR) at 0.024 lb ai/1,000 sq ft broadcast (0.6 oz). REI 24 hr.
- acephate/fenpropathrin (Valent Tame/Orthene)
- acetamiprid (Tristar 30SG) at 0.75 to 1.5 lb ai/100 gal (4 to 8 oz). REI 12 hr.
- azadiractin (Azahar)—Some formulations are OMRI-listed for organic use.
- *Beauvaria bassiana* (Botanigard, Mycotrol, Naturalis L)—Some formulations are OMRI-listed for organic use.
- beta-cyfluthrin (Tempo SC) at 45 to 160 ml (1.5 to 5.4 ounces) per 100 gal. of water.
- bifenthrin (Talstar) at 0.168 to 0.335 lb ai/1,000 sq ft. REI 12 hr. Restricted use pesticide.
- *Burkholderia* spp. (Venerate XC) at 4 to 8 pints per 100 gal.
- canola/pyrethrins (EB Stone, Earth-tone, Worryfree)—Some formulations are OMRI-listed for organic use.
- capsaicin (Captiva)—Check host plant is listed; dilute 1 to 2 pints/A and apply by spraying every 4–7 days.
- carbaryl (Sevin)—Application depends on specific host.
- chlorfenapyr (Pylon) at 0.08 to 0.16 lb ai/100 gal. REI 12 hr.
- chlorpyrifos (Vulcan) at 1/12 to 1/6 fl oz per gal on 0.5 to 1 pint per 100 gal, no more than 2.8 quarts/A per year.
- *Chromobacterium* (Grandevo)—Application rates based on host plant.
- cinnamaldehyde (Seican)—Variable rates for the first appearance, common and high pressure.
- cinnamon oil (Cinnerate) at 13 to 64 fl oz/100 gal, 50 to 210 gal/A. cottonseed oil, peppermint oil, geraniol, rosemary oil (Furious) at 22 to 33 fl oz/A or 3 fl oz/gal for 1,000 sq ft. WA only.
- cyantraniliprole (Mainspring) at 0.013 to 0.1 lb ai/100 gal. REI 4 hr.
- cyclaniliprole/flonicamid (Pradia) at 10 to 17.5 fl oz/100 gal.
- cyfluthrin (Decathlon) at 1.9 oz/100 gal. REI 12 hr.
- cyhalothrin (Declare) max rate at 0.12 lb ai/A.
- deltamethrin (D-Fense Dust) at 8 oz product per 1,000 sq ft or as a thin layer.
- diazinon (Diazinon AG600) WBC at 0.5 fl oz per 3 gal water or 12.75 fl oz per 100 gal water.
- dimethoate (Dimethoate 40)—Ornamental plants in nurseries only, do not use in greenhouses.
- dinotefuran (Safari 20SG) at 0.1 to 0.2 lb ai/1,000 ft sq; 0.05 to 0.1 lb ai/100 gal. REI 12 hr.
- fenpropathrin (Tame 2.4 EC) at 5.33 to 10.67 per 100 gal.
- flonicamid (Aria) at 0.067 to 0.09 lb ai/100 gal. REI 12 hr.
- flupyradifurone (Altus) at 10.5 to 14 fl oz/A. REI 4 hr.
- geraniol (Ecotec Plus) at 1 to 4 fl oz/100 gal. OMRI-listed for organic use. REI 0 hr.
- GS-omega/kappa -Hxtx-Hv1a (Spear T Biological Insecticide) at 0.138 to 1 lb ai/A. PHI 0 days. REI 4 hr. Do not exceed 2 lb ai/A per year.
- imidacloprid (Marathon II) at 0.027 oz ai /100 gal foliar. REI 12 hr. Drench and irrigation permitted.
- *Isaria fumosorosea (*PFR 97) at 0.175 to 3.5 lb ai/100 gal foliar. REI 4 hr.
- kaolin (Surround WP)—Some formulations are OMRI-listed for organic use.
- lambda-cyhalothrin (Scimitar GC) at 0.013 to 0.043 lb ai /100 gal. REI 24 hr.
- malathion (Malathion 8 Aquamul) at 1 pint in 100 gal of water as a dilute spray.
- *Metarhizium anisopliae* strain F52 (Met52 EC)
- methiocarb (Mesurol 75W) at 0.375 to 0.5 lb ai/100 gal. REI 12 hr. Restricted use pesticide.
- mineral oil/petroleum distillate (Biocover LS)—Some formulations are OMRI-listed for organic use.
- naled (Dibrom 8)—Application varies by application type and crop
- neem oil (Nimbiosys) at 0.5% to 1% solution every 7 to 14 days.
- novaluron (Pedestal) at 0.039 to 0.052 oz ai/100 gal. REI 12 hr.
- permethrin (Perm-up) at 12.8 oz/A (0.2 lb ai/A).
- phosphine (Eco2Fume) RUP space fumigations—200 to 1500 ppm dosage.
- piperonyl butoxide, pyrethrins (Evergreen Crop Protection, Pyronyl)—Various products, see label for application rates.
- potassium laurate (M-pede)—Apply a 1 to 2% v/v solution.
- pyrethrins (Lynx EC, Pyganic)—Various products, see label for application rates.
- pyridalyl (Overture)—Mix 8 oz to 100 gal water to treat 20,000 sq ft of area.
- pyrifluquinazon (Rycar) at 0.034 to 0.045 lb ai/100 gal. REI 12 hr. Limit 2 treatments per crop.
- pyriproxyfen (Distance) at 0.041 to 0.054 lb ai/100 gal (6 to 8 fl oz) foliar. REI 12 hr.
- s-kinoprene (Enstar AQ) at 0.012 to 0.024 lb ai/10,000 sq ft. REI 4 hr.
- sodium borate (Prev-Am) fungicide + insecticide—Label rates vary by application type.
- soybean oil (Golden Oil Spray)—Some formulations are OMRI-listed for organic use.
- spinetoram (XXPire) at 3.5 oz/100 gal; 7 oz/A.
- spinosad (Entrust) at 0.047 to 0.078 lb ai/100 gal. OMRI-listed for organic use.
- spirotetramat (Kontos) at 0.027 to 0.053 lb ai/100 gal. REI 24 hr.

- sulfur (Drexel Suffa) at 2 to 10 pints of this product in 100 gal water by ground application or 2 to 20 pints by air.
- tau-fluvalinate (Mavrik Aquaflow) at 0.063 to 0.156 lb ai/100 gal. REI 12 hr.
- thiamethoxam (Meridian 0.33G) suppression; 7 to 9 lb/5,000 sq ft or 60 to 80 lb/A.
- tolfenpyrad (Hachi-Hachi) at 0.14 to 0.33 lb ai /100 gal. REI 12 hr.

Greenhouse ornamentals—Weevil (adults)

Including

Black vine weevil (*Otiorhynchus sulcatus*)

Pest description and crop damage Adult weevils are black, 0.4 inch long, and appear May through July. Larvae are C-shaped, legless, and white with tan heads, up to 0.5 inch in size. Adult weevils cause a characteristic notching in the leaves of host plants. This feeding damage is relatively minor. The real damage is done by the larvae, which feed through the winter and spring on the root systems of host plants. Infested plants are stunted, grow poorly, and may die.

Biology and life history Weevils overwinter as larvae in the soil. Feeding may occur throughout mild winters. In April to June, larvae pupate, and adult emergence occurs. Adults are night feeders that remain in the soil or in debris at the base of the plant during the day, then climb up to feed on leaves. Adult weevils cannot fly, but walk or are carried from one location to another. Also, all adults are females capable of laying eggs. Adults are slow moving and should not be confused with swifter predacious ground beetles. Eggs are laid in clusters in or on the soil from June to September. The eggs hatch and the larvae immediately wriggle through the soil to begin feeding. There is one generation per year.

Scouting and thresholds Observe leaves for first signs of notching in early summer (primroses are an inexpensive preferred host and can be used as an indicator plant for conifer field production. Confirm the presence of adults by night inspection of foliage on warm, still evenings. Or, look for adults by day in debris at the base of the plant. Laying a small piece of cardboard at the base of the plant provides a refuge that you can check easily in the early morning. Commercial root weevil traps are available.

Management—biological control (larvae)

Natural enemies include:

- carabid (ground) beetles several species
- pathogenic nematodes (*Heterorhabditis heliothidis*, *H. medidis*, *Steinernema carpocapsae*, *S. feltiae*, *S. kraussei*, *S. riobravis*)—Adequate soil moisture and temperature are necessary for success.

Management—chemical control

- abamectin (Aracinate) at 5 mL per 2 inches of cumulative trunk diameter at 4.5 ft above the ground.
- acephate (Orthene TR, Precise) at 0.024 lb ai/1,000 sq ft broadcast (0.6 oz). REI 24 hr.
- acetamiprid (Tristar 30SG) at 0.81 to 1.59 oz ai/100 gal. REI 12 hr.
- azadirachtin (Azahar, Azatin XL)—Some formulations are OMRI-listed for organic use.
- *Bacillus thuringiensis (*grubGONE!, beetleGONE!)—Do not apply more than 6 lb 14 oz of product per 1000 sq ft per year.
- *Beauveria bassiana* (Botanigard, Mycotrol, Nautralis L)—Some formulations are OMRI-listed for organic use.
- beta-cyfluthrin (Tempo Ultra GC) at 45 to 160 ml/100 gal water.
- bifenthrin (Talstar S) at 0.168 to 0.335 lb ai/1,000 sq ft. REI 12 hr. Restricted use pesticide.
- *Burkholderia* spp. (Venerate CG)—Rate depends on application type.
- canola oil (Mighty)—Do not apply more than 2.5 gal per 100 sq ft per application. Do not reapply within 3 days.
- capsaicin (Prevasyn) at 0.5 to 1 tsp/gal water to cover 350 sq ft.
- carbaryl (Sevin)—Application depends on specific host.
- chlorantraniliprole (Acelepryn) at 0.0625 to 0.25 fl oz (0.00082 to 0.0033 lb ai) per inch DBH of tree or per foot height of shrub.
- chlorpyrifos (Vulcan) at 1/12 to 1/6 fl oz per gal on 0.5 to 1 pint per 100 gal, no more than 2.8 quarts per acre/year.
- *Chromobacterium* (Grandevo)—Application rates based on host plant.
- cinnamon oil (Gargoil)—Apply 1 to 2 quarts per acre, depending on pressure, in a minimum of 50 gal water.
- clothianidin (Arena 0.25G)—Only apply to moist soil, rates vary by height and DBG (trees).
- cottonseed oil, peppermint oil, geraniol, rosemary oil (Furious) at 22 to 33 fl oz/A or 3 fl oz/gal for 1,000 sq ft. WA only.
- cryolite (Gowan Cryolite Bait) at 0.5 to 1.5 lb per 1,000 sq ft.
- cyantraniliprole (Mainspring) at 12 to 20 fl oz per acre for bluegrass weevil.
- cyclaniliprole/flonicamid (Pradia) at 10 to 17.5 fl oz/100 gal.
- cyfluthrin/imidacloprid (Discus N/G) at 0.063 lb ai/100 gal foliar; 0.009 to 0.014 lb ai/1,000 ft soil. REI 12 hr.
- cyhalothrin (Scion) at 0.16 to 0.33 fl oz/gal water or 0.5 to 1.0 fl oz/3 gal water
- DDVP (nuvan fog 5%)—Use is prohibited on food plants
- deltamethrin (D-Fense Dust) at 8 oz product per 1,000 sq ft or as a thin layer.
- diatomaceous earth (PermaGuard)—Minimum 1 lb to 2 gal water; max 1 lb to 25 gal water.
- diazinon—Various formulations, refer to label for application rates.
- diflubenzuron (Dimilin, Diflumax)—Apply at a rate of 8 to 16 oz per 100 gal water when adult weevils are present and/or to newly expanded growth. Will not control adult weevils but will reduce the reproductive potential of adult weevils, resulting in decreased egg hatch.
- dimethoate (dimethoate 400 EC)—Varies by host, see label for application rates.

- dinotefuran (Safari 20SG) at 0.1 to 0.2 lb ai/1,000 ft sq; 0.05 to 0.1 lb ai/100 gal. REI 12 hr.
- fenpropathrin (Valent Tame 2) at 10.33 fl oz/100 gal/A.
- flupyradifurone (Altus) at 2.8 to 3.7 fl oz/100 gal.
- imidacloprid (Marathon) at 0.027 oz ai /100 gal foliar. REI 12 hr. Drench and irrigation permitted.
- indoxacarb (Provaunt)—Labelled for use in WA only
- *Isaria fumosoroseus (*PFR 97) at 4 to 8 fl oz per pot as soil treatment. REI 4 hr. Some formulations are OMRI-listed for organic use.
- kaolin (Novasource) at 6.25 to 37.5 lb/A. Suppression only.
- lambda-cyhalothrin (Cyonara 9.7) at 1.5 to 5 fl. oz per 100 gal. or 44 to 148 mL per 100 gal.
- malathion (Fyfanon) at 2.5 lb ai/100 gal; max 2 applications per year, 10-day min retreatment interval.
- *Metarhizium anisopliae* (Met52G) at 1.5 to 3.0 lb product per cubic yard growing medium.
- naled (Dibrom 8)—Application varies by application type and crop
- neem oil (EcoWorks)—Low use: 1 pint/A; Mid use: 2 pints/A; High use: 4 pints/A. Repeat 7-14 days.
- novaluron (Rimon 0.83EC)—For container-grown ornamentals in greenhouses, shade houses and outdoor nurseries.
- permethrin (Permethrin 3.2 AG)—Restricted use pesticide.
- phosmet (Imidan) at 0.75 to 1 lb (0.5 to 0.7 lb ai) per 100 gal.
- phosphine (Eco2Fume Gas)—Application rate dependant on ambient temperature.
- piperonyl butoxide (Evergreen Pro, Pest Xpert, Pyrenone Crop Spray)—Many products, see labels for application rates.
- pyrethrins (Lynx EC 1.4) at 16 fl oz to 64 oz/A
- pyridiben (Sanmite) at 6.4 to 9.6 oz/A –or– 0.15 to 0.22 oz per 1,000 sq ft.
- spinosad (Entrust) at 0.047 to 0.078 lb ai/100 gal. OMRI-listed for organic use.
- tau-fluvalinate (Mavrik Aquaflow) at 4 to 10 fl oz per 100 gal.
- thiamethoxam (Flagship 25WP) at 8 oz/100 gal or 17 oz/A.
- trichlorton (Dylox 420 SL) at 5.2 to 6.9 fl oz per 1,000 sq ft (225 to 300 fl oz per acre).

Greenhouse ornamentals—Whitefly

Greenhouse whitefly (*Trialeuroides vaporarium*)
Silverleaf whitefly (*Bemisia argentifolia*)
Sweet potato whitefly (*Bemisia tabaci*)

Pest description and crop damage Whitefly outbreaks are often associated with warm temperatures and susceptible plant material. The small football-shaped eggs are laid on the leaf underside with white wax deposits. Small, clear-to-beige, flat scales are evidence of immature whiteflies. The adult whitefly are tiny yellow-bodied insects with white wings that fly when disturbed.

Biology and life history The eggs are generally laid in clusters on the underside of leaves. The eggs hatch in about 9-12 days (70°F), and move to feeding sites, where they remain throughout the rest of the juvenile stages. The nymphs go through several instars or molts, and then a final pupal stage from which the adult emerges. Egg to adult development takes about 32-39 days.

Scouting and thresholds Scout for whiteflies on incoming transplants. Look for the adults on leaf undersides and yellow sticky cards. The eggs can be seen near white wax deposits with a hand lens.

Management—biological control

Natural enemies include:

- lady beetle (*Delphastus pusillus*)
- parasitic wasp (*Encarsia formosa*; *Eretmocerus mundis*)—*Encarsia* has been very successful in some greenhouses.
- pathogenic fungi (*Beauveria bassiani*; *Paecilomyces fumosoroseus*)

Management—chemical control

Direct control efforts at larvae feeding on leaf surfaces.

- abamectin (Avid 0.15) at 0.009 lb ai/100 gal (8 fl oz). REI 12 hr. Suppression.
- acephate (Precise, Orthene TR) at 0.024 lb ai/1,000 sq ft broadcast (0.6 oz). REI 24 hr.
- acetamiprid (Tristar 30SG) at 0.1 to 0.5 lb ai/100 gal (2.7 to 5.3 oz). REI 12 hr.
- afidopyropen (Ventigra) at 4.8 to 7.0/100 gal.
- azadiractin (Azahar, Azatin XL)—Some formulations are OMRI-listed for organic use.
- *Beauvaria bassiana (*Botanigard, Mycotrol, Naturalis L)—Some formulations are OMRI-listed for organic use.
- beta-cyfluthrin (Tempo Ultra WSP)—Apply as a dilute spray using 1-3 packets of product per 100 gal water, use higher rate for severe infestations.
- bifenthrin (Talstar) at 0.168 to 0.335 lb ai/1,000 sq ft. REI 12 hr. Restricted use pesticide.
- buprofezin (Talus 70DF) at 0.38 lb ai/A. REI 12 hr.
- *Burkholderia* spp. (Venerate XC) at 4 to 8 pints per 100 gal.
- canola oil/pyrethrins (E.B. Stone, Earth-tone, Worryfree)—Some formulations are OMRI-listed for organic use.
- capsaicin, garlic oil (Captiva)—Dilute 1 to 2 pints of Captiva® per acre and apply by spraying every 4-7 days.

- carabaryl (Sevin SL) at 1 quart per acre or per 100 gal (0.75 fl oz per 1,000 sq ft).
- chlorpyrifos (Vulcan) at 1/12 to 1/6 fl oz per gal on 0.5 to 1 pint per 100 gal, no more than 2.8 quarts per acre/year.
- *Chromobacterium* (Grandevo)—Application rates based on host plant.
- cinnamaldehyde (Seican)—Variable rates for first appearance, common and high pressure.
- cinnamon oil (Gargoil)—Apply 1 to 2 quarts per acre, depending on pressure, in a minimum of 50 gal water.
- clothianidin (Arena 0.25G) at 0.45 to 0.63 oz ai /100 gal. REI 12 hr. Soil treatment refer to label.
- corn oil (Circadian Sunrise) at 1 to 3 oz per gal; Agitate solution throughout application.
- cottonseed oil, peppermint oil, geraniol, rosemary oil (Furious) at 22 to 33 fl oz/A or 3 fl oz/gal for 1,000 sq ft. WA only.
- cyantraniliprole (Mainspring) at 0.013 to 0.1 lb ai/100 gal foliar or 0.16 lb ai/100 gal drench. REI 4 hr.
- cyclaniliprole/floconamid (Pradia) at 10 to 17.5 fl oz/100 gal.
- cyfluthrin (Decathlon) at 1.9 oz/100 gal. REI 12 hr.
- cyfluthrin/imidacloprid (Discus N/G) at 0.063 lb ai/100 gal foliar; 0.009 to 0.014 lb ai/1,000 ft soil. REI 12 hr.
- cyhalothrin (Declare) RUP at 0.01 to 0.02 lb/A or 1.02 to 2.05 fl oz/A.
- deltamethrin (D-Fense Dust) at 8 oz product per 1,000 sq ft or as a thin layer.
- diatomaceous earth (PermaGuard) minimum 1 lb to 2 gal water; max 1 lb to 25 gal water.
- diazinon (Diazinon AG600) at 0.5 fl oz per 3 gal water or 12.75 fl oz per 100 gal; spray when whiteflies first appear.
- diflubenzuron (Adept) at 0.5 oz ai/100 gal.
- dimethoate (dimethoate 400 EC)—Varies by host, see label for application rates.
- dinotefuran (Safari 20SG) at 0.1 to 0.2 lb ai/1,000 sq ft; 0.05 to 0.1 lb ai/100 gal. REI 12 hr.
- etoxazole (Eschaton TR)—Apply when foliage is dry and greenhouse temperature is between 60°F and 80°F.
- fenazaquin (Magus Miticide) at 0.15 to 0.3 lb ai/A. REI 12 hr.
- fenpropathrin (Valent Tame 2) at 10.67 to 16 fl oz/100 gal with Orthene Turf, Tree & Ornamental Spray at 0.34 lb/100 gal.
- fenpyroximate (Akari 5SC) at 16 to 32 fl oz per 100 gal water, do not apply through any type of irrigation system or ULV equipment.
- flonicamid (Aria) at 0.09 to 0.134 lb ai/100 gal. REI 12 hr.
- flupyradifurone (Altus) at 10.5 to 14 fl oz/A. REI 4 hr.
- geraniol, peppermint and rosemary oil (Keyplex Ecotrol) at 16 to 48 fl oz/100 gal; spray at first appearance, every 5-7 days.
- gs-omega/kappa-Hxtx-Hv1a (Spear T Liquid)—Application varies by application type.
- imidacloprid (Marathon II) at 0.027 oz ai /100 gal foliar. REI 12 hr. Drench and irrigation permitted.
- *Isaria fumosorosea (*PFR 97) at 0.175 to 3.5 lb ai/100 gal foliar. REI 4 hr. Some formulations are OMRI-listed for organic use.
- lambda-cyhalothrin (Scimitar GC) at 0.023 to 0.043 lb ai/100 gal. REI 24 hr.
- malathion (Fyfanon) at 2.5 lb ai/100 gal; max 2 applications per year.
- *Metarhizium anisopliae* strain F52 (Met52 EC)
- mineral oil (Year-Round Spray oil)—Many are OMRI-listed.
- naled (Dibrom 8)—Application varies by application type and crop
- neem oil (EcoWorks)—Low use: 1pint, mid use: 2 pints, high use: 4 pints (per acre), repeat 7-14 days.
- novaluron (Pedestal) at 0.039 to 0.052 oz ai/100 gal. REI 12 hr.
- permethrin (Bonide Eight)—Application variable depending on specific host plant.
- piperonyl butoxide (Evergreen Pro, Pest Xpert, Pyrenone Crop Spray)—Many products, see labels for application rates.
- potassium laurate (several labels)—Some formulations are OMRI-listed for organic use.
- pymetrozine (Endeavor) at 1.25 to 2.5 oz ai/100 gal. REI 12 hr.
- pyrethrins (Lynx EC 1.4) at 16 to 64 fl oz/A.
- pyridaben (Sanmite) at 4 to 6 oz/100 gal. REI 12 hr.
- pyrifluquinazon (Rycar) at 0.023 to 0.045 lb ai/100 gal. REI 12 hr. Limit 2 treatments per crop.
- pyriproxyfen (Distance) at 0.041 to 0.054 lb ai/100 gal (6 to 8 fl oz) foliar. REI 12 hr.
- s-kinoprene (Enstar AQ) at 0.012 to 0.024 lb ai/10,000 sq ft. REI 4 hr.
- sodium borate (Prev-Am) fungicide + insecticide—Label rates vary by application type
- soybean oil (Golden Oil Spray)—Some formulations are OMRI-listed for organic use.
- spinetoram (XXPire) at 2.75 (78 g)/100 gal.
- spiromesifen (Judo) at 1 to 4 fl oz/100 gal. REI 12 hr.
- spirotetremat (Kontos)—No more than 25 fl oz per acre of nursery per season; dosage by # pots treated with the product.
- tau-fluvalinate (Mavrik Aquaflow) at 0.063 to 0.156 lb ai/100 gal. REI 12 hr.
- thiamethoxam (Flagship 25WG) as fogger. REI 12 or 24 hr.
- tolfenpyrad (Hachi-Hachi) at 0.14 to 0.33 lb ai /100 gal. REI 12 hr.

Landscape

Michael R. Bush and Sharon J. Collman

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INCLUDES MANAGEMENT OPTIONS FOR COMMERCIAL AND HOME USE

In all cases, follow the instructions on the pesticide label. The *PNW Insect Management Handbook* has no legal status, whereas the pesticide label is a legal document. Read the product label before making *any* pesticide applications.

Not all users of the *PNW Insect Management Handbook* are from the states of Washington, Oregon or Idaho. Every effort is made to ensure that the active ingredients listed here are currently registered for the host/pest use in these three states. While many of these pesticides are registered in all states, check to ensure the listed product is registered and legal for the same uses in the state where the application is planned.

Pesticide products are arranged alphabetically by common name of the active ingredient and are *not* listed in order of preference or superiority of pest control. These products are registered to control pests found in ornamentals and home landscape plants only. These products may not be registered (thus legal) for all host plants that a pest can attack and some products may be phytotoxic to certain host species. Check the label to be certain the product you select is registered for both the host plant and the pest you plan to treat.

Protect Pollinators:

See: How to Reduce Bee Poisoning from Pesticides in this handbook or at https://catalog.extension.oregonstate.edu/pnw591

See: Neonicotinoid Pesticides and Honey Bees
https://pubs.extension.wsu.edu/neonicotinoid-pesticides-and-bees

Many insecticides are highly toxic to honey bees, bumble bees and other insect pollinators. Some insecticides should not be applied at any time during plant bloom, while others should be applied only in the early morning hours and/or late evening when pollinators are not active. Refer to the product label for bee toxicity and proper application timing. Avoid spraying insecticides on blooming flowers or weeds surrounding targeted host plants. Always take simple steps, like removing (mowing) blooming clover from lawns adjacent to garden areas, before applying materials that are hazardous to bees. In all cases, when given the choice, select the least hazardous product to bees when any plant around the targeted host plant is in bloom. Avoid using dusts whenever possible, as dusts will inevitably adhere to the bee hairs (like pollen). Liquid spray formulations are preferred for bee safety. In Washington, it is illegal for homeowners to spray host plants at heights greater than ten feet. Applications at these heights greatly increase the risk of pesticides drifting into non-target areas such as streams, neighboring yards, blooming plants, or onto the applicator themselves. Whenever the host plant is higher than ten feet, a professional pesticide applicator should be called, or a non-pesticide option chosen. Check local regulations in your state.

Resources

Books

Chastagner, G.A., Byther, R., Antonelli, A.L., DeAngelis, J. and Landgren. 1997. Christmas Tree Diseases, Insects and Disorders in the Pacific Northwest: Identification and Management. Washington State University Cooperative Extension. 154 pp.

Cranshaw, W. 2004. Garden Insects of North America. Princeton Field Guides.

Furniss, R.L. and V.M. Carolin. 1980. Western Forest Insects. USDA Forest Service, Misc Pub 1339. Goheen, E.M. and E.A. Willhite. 2006. Field Guide to the Common Diseases and Insect Pests of Oregon and Washington Conifers. R6-NR-FID-PR-01-06. ISBN 0-16-076244-8. 325 pp. Johnson, W.T. and H.H Lyon. (1991). Insects That Feed on Trees and Shrubs. 2nd ed., Cornell University Press.

Websites

Hortsense for homeowners in Washington. Includes diagnostic tools and management recommendations for insects, weeds and diseases—http://hortsense.cahnrs.wsu.edu/Home/HortsenseHome.aspx

Lepidoptera of the Pacific Northwest: Caterpillars and Adults. 2003. Jeffrey C. Miller and Paul Hammond. Forest Health Technology Enterprise Team, U.S. Forest Service, USDA. FHTET-03-11. See https://andrewsforest.oregonstate.edu/publications/3739. National Pesticide Information Center (NPIC) has both a website and people trained to answer specific questions about pesticides. Information is available in several languages. See

http://npic.orst.edu/ or call 1-800-858-7378.

Pesticide Information Center Online (PICOL) is a database for searching currently registered products in Washington and Oregon. https://picol.cahnrs.wsu.edu

*PNW Insect Management Handbook i*s available online at http://pnwhandbooks.org/insect. The website includes pictures of most pests. (*See* also: PNW Disease Management Handbook online. http://pnwhandbooks.org/plantdisease).

Common Landscape Pests

A list of the arthropod pests and pesticides for each landscape plant would be lengthy and repetitive. To conserve space, we have generated a list of common pests that can plague a range of ornamental plants, shrubs, and trees (both deciduous and coniferous) in PNW landscapes. Since this is a subset of plants found in home landscapes, the homeowner and applicator must refer to the pesticide label to determine whether any pesticide product can be legally and safely applied to specific plants in their home landscape.

Landscape pests—Aphid

Order Hemiptera; Family Aphididae

Pest description and damage Several species of aphids feed on the foliage, stem, flower, bud, bark or root tissues of conifer and deciduous trees, shrubs as well as other plants in landscapes. Aphids tend to be small (0.0625 to 0.125 inch long), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Body color varies (black, green, pink, yellow, mottled, striped, etc.), but most aphids tend to match host plant coloration. Aphids tend to feed in colonies on the new or most succulent plant tissues. Feeding damage to shrubs, trees and mature plants is usually minor, but can compromise the vigor of the host. When aphid populations are high, leaf and shoot distortion can occur. Aphids produce honeydew, a sweet, sticky secretion that collects on underlying plant tissues and encourages growth of a black sooty mold. In addition to cosmetics, honeydew becomes a sticky nuisance when it falls on decks, cars, or other landscape surfaces. Some aphids are vectors of plant diseases, particularly viruses.

Biology and life history Most aphid species have similar, but complicated life cycles. They tend to overwinter in the egg stage on perennial host plants. Overwintering eggs hatch early in the spring. Newly hatched aphids are found around and on the emerging leaf and flower tissues. Later in the spring, aphid colonies are found on the underside of leaves, near flowers or within fruit clusters. During the growing season, some aphids give birth to live offspring without mating. Some aphid species undergo multiple generations and can build up high densities quickly. There may be as few as two generations or as many as 16 generations each year, depending on the species and climate. Some aphids are host plant specific, while others live on a wide variety of plants and weeds, and still others switch between different hosts within each season. In the autumn, aphid colonies may produce winged females and males. The winged aphids disperse to the winter hosts, mate, and produce eggs that survive the winter on trees, shrubs or weeds.

Pest monitoring Use yellow sticky traps, or other devices to detect aphids when they fly into the landscape from weedy or alternate hosts. Aphids tend to coincide with new growth flushes that may occur after a rain event or irrigation. Begin observing shoots for aphids prior to bud break or during new growth flushes. The most efficient management occurs early in the season when aphids are less abundant. A dark plate or upside-down cup placed under the branches will show spatters of honeydew indicating the first activity and severity of the infestation. Also, check the upper surfaces of the lower leaves for honeydew. Check host plant for presence of natural enemies as well.

Management—cultural control

Wash aphids from woody plants with a strong stream of water or by wiping the aphids off a stem or leaf by hand. Aphid populations tend to be higher in plants fertilized liberally with nitrogen or heavily watered, so avoid practices that produce flushes of succulent growth.

Management—biological control

Aphids have many natural enemies, including lady beetles, syrphid fly larvae, green lacewings, and parasitoid wasps. Check host plant closely for evidence of these predators and avoid broad-spectrum insecticide applications that would disrupt these natural enemy populations. Braconid wasps are especially important parasitoids. Look for large swollen, hardened, silvery-gray aphid "mummies" indicative of an aphid parasitized by a braconid larva. These wasp larvae pupate within the host and cut a semicircular "door" in the host's abdomen, through which the adult wasps exit the host. If the mummies are intact (without circular parasite exit holes), then cut the leaf pieces and move the mummies to areas where aphids are still a problem. The parasitoid wasp is a tiny black gnat-sized insect that upon emergence will begin searching leaves for fresh aphids to parasitize. An alternative is to control ants, which "farm" aphids to harvest honeydew and protect aphids from natural enemies.

Management—chemical control:

See Table 1 in:
Chemical Control of Landscape Pests

For more information

Cranshaw, W.S. 2009. Aphids on Shade Trees and Ornamentals. Colorado State University Extension. no. 5.511

Davidson, R.M. and A.L. Antonelli. 2003. Aphids. WSU Puyallup REC. PLS-106 (https://s3.wp.wsu.edu/uploads/sites/408/2015/02/PLS-106-Aphids.pdf)

Flint, M.L. 2000. Pest Notes: Aphids. UC-IPM UC ANR Publication 7404 (http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7404.html)

Landscape pests—Bark beetle

Includes
Elm bark beetle (*Scolytus scolytus*)
Shothole borer (*Scolytus rugulosus*)
Ips spp.
Dendroctonus spp.

Pest description and damage Bark beetles are small (0.2 to 0.25 inch long), cylindrical dark-colored beetles that attack and bore into weakened branches of landscape trees and shrubs. They are pests of forest trees, ornamental shade and fruit trees, and shrubs. These beetles are primarily a problem on injured or stressed plants, but they may attack healthy plants growing adjacent to infested plants. Mature larvae are white, legless, 0.125 to 0.25 inch long that tunnel and feed within the inner bark of trees. Larvae and adults of these species bore into and weaken the cambial and vascular tissues of trees causing wilting and dieback of individual stems and branches. Trunks and branches become weaker with numerous beetle galleries. In worst cases, bark beetles can transmit diseases that then colonize and kill the host tree while the beetle feeds on the fungus.

Biology and life history Most bark beetles overwinter as mature larvae, pupae or as adults in wood galleries or 'engravings' beneath the bark of trees infested with tunneling beetle larvae. In response to warming spring temperatures, bark beetles emerge as adults, fly to susceptible hosts, and bore into buds, twigs, and trunks of host trees. After mating, female bark beetles lay small, oval whitish eggs along freshly made tunnels beneath the outer bark. As the eggs hatch, the larvae mine galleries that radiate out from the egg-laying tunnel. These galleries fill with frass and increase in diameter as the larvae grow. When mature, the larvae pupate in the galleries. The adult beetles tunnel their way out leaving circular exit holes in the bark, giving the outside surface of an infested branch or trunk a "shothole" appearance as multiple beetles exit from the host. Most bark beetles have two generations per season, but a few complete only one generation each year.

Pest monitoring Examine branches in late spring for holes that are 0.08 inch in diameter, oozing sap, and sawdust. In stone fruits, these holes are sealed with gummy ooze accompanied by a sawdust-like frass created by the larvae. Beetles are attracted to unhealthy trees and damaged tissues. Check for a small hole at the node or base of a bud or bud scar on sickly branches. Monitor bark beetles by hanging pheromone traps. There is potential to attract adult bark beetles into an area so do not place these traps on susceptible (unhealthy) hosts.

Management—cultural control

The best management strategy is to keep trees healthy with proper pruning, adequate water, and fertilizer. Healthy trees can fight off the beetles by plugging entry holes or washing out invading beetles with sap and resins. Remove and destroy any infested wood on the tree and do not pile infested green wood, especially cherry wood, in your home landscape. Once the bark dries and sloughs off, cut wood is no longer a host for the beetles. Whitewash trunks of young trees to prevent sunburn to smooth bark and thus reduce potential attack by shothole borer and other bark beetles. Sticky adhesive products applied to the trunk may be effective.

Management—biological control

There are a number of parasitoid wasps, predatory beetles and other insects that prey on bark beetles. Birds, especially woodpeckers, will scavenge up and down the bark surface to feed on emerging beetles.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

For more information

Punches, J. 2012. Cedar and Redwood Bark Beetles of Southwest Oregon. Oregon State University Extension Service Seybold, S. J., T. D. Paine, and S. H. Dreistadt. 2011. Bark Beetles. Pest Notes: UC ANR Publication 7421 (http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7421.html)

Landscape pests—Caterpillar

Order Lepidoptera

Pest description and damage Caterpillars are the larvae of butterflies and moths. The size of mature caterpillars is highly variable ranging from tiny (less than 0.1 inch in length) leafminers that tunnel between the surface of plant leaves to large silk moth caterpillars or hornworms that reach 2.5 to 4 inches long. Caterpillars tend to have long cylindrical bodies with a visible head capsule, six true legs on the thorax and a series of five pair or fewer prolegs on the abdominal segments. Most caterpillars have chewing mouthparts (mandibles) that they use to bite, chew and defoliate leaf tissues. These larvae are variable in size, shape, color and hairiness. Some caterpillars are so small that they fit inside the confines of seeds, or "mine" the tissues between the upper and lower leaf surfaces (hence the name "leafminers"). Some caterpillars burrow into wood, roots, or buds. Other caterpillars can be one to three inches long and resemble twigs or branches. Caterpillars may be hairless, while others may have hairs that are thick, bristle-like, soft and silky, or even branched, spiny and stinging.

Biology and life cycle Moths and butterflies have complete metamorphosis: egg, caterpillar, pupa (chrysalis, cocoon or lined cell in the soil or wood) and adult. Moths and butterflies may be strong or weak fliers, and some are flightless. Knowing flight ability provides clues on whether these caterpillars will build up quickly in an area.

Pest monitoring Look for caterpillars or their fecal pellets below host plants (use sticky plates hung horizontally below suspected hosts or check leaf surfaces). Some caterpillars make visible webbing trails, tie leaves together or create tents. Pheromones are available to attract male moths to sticky traps.

Management—cultural control

Manage and minimize weeds, grasses, and debris in the vegetable garden that provide cover. Encourage natural enemies of caterpillars like birds and spiders.

Management—biological control

Most caterpillars are eaten by other insect predators or are heavily parasitized by wasps and parasitoid flies. Plant flowering species that provide nectar and pollen to attract these parasitic wasps and flies into the home landscape. Tiny *Trichogramma* wasps parasitize the eggs. Many small mammals, bats and especially birds feed on moths, larvae, pupae and some eggs. These parasitoids and predators that feed on the caterpillars can be purchased, then released in the home landscape. Additionally, one can manage the landscape in a way that keeps the parasitoid and predators healthy. This may mean tolerating a low number of these pests in your landscape plants.

Management—chemical control:

See Table 2 in:

Chemical Control of Landscape Pests

Landscape pests—Cricket and katydid

Includes

True cricket (*Gryllidae*)

Katydid (*Tettigoniidae*) including Mormon cricket (*Anabrus simplex*, a shield-backed katydid)

Pest description and damage Most mature crickets, Mormon crickets and katydids have a leathery pair of front wings and membranous pair of hind wings; females have a sword-like ovipositor and range in size from a field cricket at 0.5 inch long to up to 2 inches for katydids and the Mormon cricket. The true crickets have a more flattened back than grasshoppers or katydids. Males stridulate using various structures, e.g., crickets rub their forewings together and lift their wings to amplify the sound. Crickets are omnivorous scavengers and eat seeds, organic detritus, or dead insects. They are rarely a problem in landscapes and provide a pleasant nocturnal sound outdoors. Mormon crickets are technically katydids yet their colors are variable, and their wings reduced so they are flightless. Mormon cricket populations occasionally become epidemic. They migrate by crawling and can move more than one mile per day. Crossing roads, their crushed bodies form slick masses that become a safety hazard for motorists. Katydids, or long-horned grasshoppers, are generally green with oval, leathery wings. Their body is flattened from side to side and the wings are leaf-shaped, even bearing veins, fungal leaf spots and holes like damaged leaves. They feed on tender leaves of deciduous plants (especially oaks).

Biology and life history The true crickets lay eggs by pushing their ovipositor into the soil and inserting the eggs. The overwintering eggs hatch in spring. The young look like mini adults. Older instars develop visible wing buds. Some species of crickets lay eggs almost continuously through the summer. Katydids lay their flat eggs overlapping like shingles on the bark of twigs in autumn.

Pest monitoring This group is mostly nocturnal; small numbers rarely warrant control measures.

Management—cultural control

Usually none needed.

Management—biological control

Many animals, birds, and insectivores eat grasshoppers, crickets, and katydids. There are commercially-packaged micro-organisms that serve as bio-control specifically for these insect pests.

Management—chemical control

Not recommended for home landscapes.

Landscape pests—Cutworm, fruitworm and armyworm

Order Lepidoptera: Family Noctuidae

Pest description and damage The moth family Noctuidae contains over 2,000 species of caterpillars including cutworm, fruitworm and armyworm. The variegated cutworm is one of the most commonly found caterpillar invading gardens and home landscapes in the PNW. Most mature larvae are dark with brown and white markings and measure 0.5 to 0.75 inch in length. Damage includes leaf and shoot feeding and may include cutting plants off at the soil line. Cutworm larvae are nocturnal, and their damage easily confused with slugs, but cutworms make clean cuts, while slugs rasp from the side of the plant leaving a ragged edge. Cutworms leave pellet-shaped droppings, while slugs deposit S-shaped sludge wrapped in slime.

Biology and life cycle Cutworms are found throughout the year but are most damaging early in the spring when overwintering larvae feed on emerging plant tissues on desirable landscape plants. In the Pacific Northwest, small cutworms feed at night in mid-December and January. Larvae,

or the shiny red-brown, bullet-shaped pupa case, also may be unearthed while weeding in spring and early summer. Eggs are laid in patches on plants or nearby grasses.

Pest monitoring Watch plants for fecal pellets near defoliated leaves by day or search plants for larvae at night in late winter in milder climates.

Management—biological control

Several predators including ground beetles feed on cutworms and multiple wasps and flies parasitize them. Encourage natural enemies of cutworms like birds, ground beetles, and spiders. Ground scratching birds may also play a role in keeping numbers low.

Management—cultural control

Control weeds, grasses, and debris on the soil surface in the vegetable garden that provide cover for marauding larvae. Using a flashlight at night, remove cutworm larvae by hand picking. Sort through the loose soil at the base of plants to find larvae in the daytime.

Management—chemical control:

See Table 2 in:

Chemical Control of Landscape Pests

For more information

Peterson, Merrill. 2012. PNW Moths (http://pnwmoths.biol.wwu.edu/browse/)

Landscape pests—Earwig

Primarily European earwig (*Forficula auricularia*)

Pest description and damage This introduced, nocturnal insect can devastate seedlings, flowers, leaves, and fruit. Adults are brown in color and roughly 0.5 inch long. Easily recognized by the hind pinchers, called cerci, they are reviled by gardeners. The adults are winged, but the hind wings are folded under the short and stubby fore wings. Immature earwigs resemble adults but are smaller, lack wings and may be paler in color. While despised by homeowners, earwigs also can be beneficial by feeding on aphids and other small insects. They also scavenge dead bugs, plant debris, and feed on live plant tissue. Earwigs chew irregular, variable-sized holes in leaves. Earwigs are often worse in dry eastern climates or in drier than normal years in western climates.

Biology and life cycle Females carefully tend clusters of up to thirty eggs, in small nests under rocks in the soil in winter. They clean fungi from the eggs and protect their eggs and young. In spring, the earwig "family" feeds together, but as the young mature, they go their separate ways. There is one generation a year. Earwigs are nocturnal. During the day, they *see*k moist, dark places, under stones, debris and even in flower heads and damaged fruit.

Pest monitoring Search with flashlight at night. Earwigs are omnivorous and easily attracted to fish oils and cat food in traps. Vigorously shake flowers over a box lid to knock earwigs off plants.

Management—cultural control

Remove debris and hiding places in gardens. Commercial earwig traps are available.

Management—biological control

Frogs, toads, predator beetles and duff-scratching birds are common predators. Fungi may attack eggs in winter nests.

Management—chemical control:

See Table 2 in:

Chemical Control of Landscape Pests

For more information

Flint, M.L and B. Ohlendorf. 2002. Earwigs. UC ANR Publication 74102 (http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74102.html)

Landscape pests—Eriophyid mite

Includes

Rust mite and gall mite (Family: Eriophyidae)

Pest description and damage The tiny (0.005 to 0.008 inch long) body of most eriophyid mite species is translucent and cigar-shaped tapering to the hind end, with only four legs at the front end. Most Eriophyid mite species are host specific, but as a complex, they attack a wide array of plants. Individual species attack stems, flowers, buds, leaves and needles, or feed within needle sheaths. They look like blunt, little slivers and best viewed with a 20x hand lens or scope. Tissue damage varies with the host and includes leafy and woody galls of various shapes and sizes, stunting, erineum (felt-like patches), blisters, leaf curl, rusts, silvering, russeting of fruit, witch's brooms, twisting and chlorosis of needles, big buds on some hosts, and stunting and deformities of seedlings. A few Eriophyid mites can transmit plant viruses. See specific plant hosts for more descriptive information. These mite numbers often drop or rise without human intervention. Sometimes mite populations are so abundant that the plant forms an abscission layer then drops infested tissues. The mites perish as these tissues dry out.

Biology and life history The fertilized female mites overwinter and emerge as the buds expand in spring. There are only two nymphal instars, the second instar molts into an adult after a brief resting period. The eriophyids reproduce almost through the growing season. They can complete their life cycle in as little as ten days or every two to three weeks. Mites living on leaves, flowers and fruit must migrate back onto the plant before the plant parts are dropped. At that time, they are more exposed and vulnerable to weather and natural enemies. The mites spend winter in permanent tissues on the plant such as needle sheaths, or cracks and crevices on bark or buds and other protected sites.

Pest monitoring Start by looking for silver or bronzed leaves, galls, or other symptoms. Then examine the symptoms for signs of eriophyid mites. Because eriophyid mites are so small, it takes close examination to uncover them in needle sheaths, or beneath bud scales, among the erineum, or within galls. Sometimes, mites are dislodged by striking a branch over a dark paper. At other times, it takes perseverance and a good microscope to locate mites in galls or affected plants. Wrap double-stick tape around twigs where mites can be captured and identified.

Management—cultural control

Damage caused by these mites is generally cosmetic and not a significant problem for the host plant.

Management—mechanical control

Prune out the most infested branches or pick off infested leaves if this cosmetic damage exceeds your tolerance.

Management—biological control

During migration between plant tissues, the eriophyid mites are more exposed and vulnerable to natural controls such as predatory mites, mite destroyer lady beetles, cecidomyid larvae, and other predators. Avoid using broad-spectrum pesticides that may kill predatory mites and other natural enemies.

Eriophyid mite populations often collapse on their own due to natural enemies and possibly plant defense mechanisms (extra hairs on leaves or buds, thicker plant cell walls, or plant chemicals).

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more information

Beers, E., J.F. Brunner, M.J. Willett and G. Warner (Eds.).1999. Indirect Pests Orchard Pest Management On-Line (treefruit.wsu.edu/crop-protection/opm/)

Davis, R.S. and T. Beddes. 2011. Eriophyid mites. Utah State University Cooperative Extension Fact Sheet Ent-149-11 (https://extension.usu.edu/files/publications/factsheet/eriophyid-mites2010.pdf)

Landscape pests—Gallmakers

Includes aphid, adelgid, eriophyid mite, flies, gall wasp, midge, psyllids, and sawflies

Pest description and damage Plant galls are formed in response to an interaction with insects, (as well as mites, nematodes, viruses, or fungi) and the plant tissues. Egg-laying, salivary secretions or mechanical injury initiates production of localized plant hormones that cause accelerated growth (larger plant cells or increased number of cells) of the growing tissue. The plant tissue grows around the insect or mite protecting it from weather and natural enemies. Galls can form in the developing tissues of any plant structure including leaves, buds, stems, flowers, shoots, or roots. Generally, damage is not significant to the plant, but considered unsightly by homeowners. Occasionally, infestations flare up to significant numbers and the plant will form abscission layers that cause infested leaves to drop from the host along with the insects or mites inside. Insect galls rarely kill plants and are heavily parasitized in most years. Low numbers of galls are not harmful to trees.

Several orders of insects have adopted specific gall types, and methods of control will vary with the types:

- Eriophyid mites cause infested tissues to “balloon” such as maple bladder gall mite or linden nipple gall.
- Psyllids or jumping plant lice cause leaf tips or edges to curl like psyllid in boxwood.
- Aphids form the petiole galls on cottonwood or the reddish galls on kinnikinnick;
- Adelgids such as the Cooley spruce gall adelgid form cone like galls on spruce.
- Flies and midges such as honeylocust pod gall midge, willow beaked gall midge and willow pine cone gall midge cause infested leaves, stems and buds to swill to abnormal sizes.
- Gall wasps, tiny members of the order Hymenoptera (not stinging wasps), form oak apple galls, thimbleberry galls or other galls; and
- Sawflies (Hymenoptera) commonly form willow pea galls and willow bean galls.

Biology and life history Biology is variable depending on the insect or mite initiating the gall as they oviposit or feed on sensitive plant tissues. Generally, there are two kinds of galls: closed and open. Closed galls form around and enclose the eggs of developing insects (such as tiny flies of the willow pinecone gall, pea gall, or honeylocust pod gall midge or rose galls). The enclosed insects must chew their way out of a closed gall. Open galls are formed around sucking insects (or mites) in response to the salivary juices of the insect. These galls have small openings that allow the mites or insects to move in and out of the galls or the galls crack open on drying and free the insects inside. Removing and destroying green galls before adults emerge may break the life cycle.

Chemical control often targets the adults as they emerge from the gall. Alternatively, galls can be removed before the insects have emerged, be placed in baggies in shaded areas, and the adults reared out. When the first adults emerge, insects can be identified at your local Extension office or Master Gardener clinic. Once an identification is made, appropriate control measures can be selected. In some cases, the emerging insects may be parasitoids that should be conserved, rather than destroyed. Again, proper identification of the emerging insects can assist in choosing proper management.

Pest monitoring Some species with the habit of causing significant damage to hosts, such as the honeylocust pod gall midge, can only be controlled when control measures target the adult stage. Thus, monitoring adult insect flight activity with sticky traps and repeated inspection is recommended. Degree-day or phenology models to predict adult flight are available for some gall insect species.

Management—cultural control

Most galls are an interesting partnership between plant and gall maker. Rarely are the galls numerous enough to warrant control. Most homeowners find they can tolerate gall insects once they know the plant is not going to die. Prune out or remove galls on infested twigs, buds or leaves if they are objectionable.

Management—biological control

Many gall insects are heavily parasitized once they become numerous enough for parasitoids to locate them. Pick galls and place in a sealed plastic bag with a bit of tissue to absorb moisture and wait for emergence of gall maker and parasitoids to determine the level of parasitoid activity.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more information

Hahn, J. and M.E. Ascerno. 2018. Insect and Mite Galls. University of Minnesota Extension. (https://extension.umn.edu/yard-and-garden-insects/insect-and-mite-galls)

Landscape pests—Grasshopper

Includes many species in the family Acrididae

Pest description and damage Grasshoppers, or short-horned grasshoppers, are related to crickets and katydids. There are over 600 species of short-horned grasshoppers in North America. Adults range in size from 0.75 to 1.25 inches long. They feed on plants with their chewing mouthparts. They are most abundant in hot dry climates east of the Cascade Range but do occur on the west side as well. The immature grasshoppers look like small adults, but without wings. Older immature grasshoppers may have rudimentary wing buds that become fully functioning wings in the final molt to adult. The forewings are leathery and meet in a straight line down the back. The hind wings may be clear or have red, yellow, or black bands. Body markings and colors may be brown or green or have ornate patterns of bright colors that vary with the species. Many species make a clicking sound with their wings as they fly. In some areas, especially east of the Cascades, grasshopper numbers can increase to epidemic proportions and when preferred foods are exhausted, grasshoppers move to landscapes to feed. Some species can change to a migratory phase and fly long distances to new feeding areas.

Biology and life history Grasshopper life cycles vary with the species involved. Eggs are deposited when the female pushes her ovipositor into the sand or soil in the autumn. The eggs overwinter in the soil and begin hatching in the spring. There is one generation per year. Spring temperature, excessive moisture, natural enemies, and other factors naturally reduce grasshopper numbers.

Pest monitoring Scouting for grasshoppers is based on the number of grasshoppers present in the previous fall, the number that successfully hatch, weather, temperature, and presence of natural enemies. In dryland areas, range managers and government agencies conduct surveys to assess grasshopper population levels (i.e., BLM, State Departments of Agriculture, USDA-APHIS and PPQ). Landscape professionals can consult with these agencies or land grant university Extension offices for forecasts in areas of traditionally high grasshopper infestations.

Management—cultural control

Often the sources of grasshopper infestation occur in ditches, surrounding grasslands, pastures and rangeland. Soil cultivation prior to grasshopper egg hatch can greatly reduce population outbreaks. Physical barriers (netting, floating row covers and other crop protective covers) can provide some protection from grasshoppers. In home landscapes, adults can be captured, trapped, then squashed when encountered. Placing trap crops in the home landscape can serve as a barrier to trap and intercept localized grasshopper infestations.

Management—biological control

Natural biological controls of grasshoppers include sage grouse and other wild birds, insectivorous mammals, and protozoans such as *Nosema locustae*. The larvae of several blister beetles prey on grasshopper eggs. Some studies have shown that guinea hens, geese, duck, and turkeys have reduced grasshopper populations in home landscapes, but they can also damage desirable landscape plants.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Landscape pests—Leaf beetle

Family Chrysomelidae includes many species of leaf beetle on many hosts

Pest description and damage This family of beetles includes many small, often brightly colored, but damaging beetles that feed on many plants. This family includes flea beetles that are around 0.2 inch long to the leaf beetles at around 0.4 inch long. The eggs hatch into dark alligator-like larvae with tapered bodies. The young larvae scrape the tissue from the leaves until only the veins (or skeleton of the leaf) remain. When abundant, some species can skeletonize all the leaves on large trees. At other times, they may only cause minor damage. Adults chew holes in leaves while larvae skeletonize leaves.

Biology and life history Biology varies with the many species of leaf beetles in the PNW. Adults usually emerge from hibernation in spring, mate, and lay clusters of colored eggs on leaves. Larvae feed through the spring or summer. The number of generations per season depends on the species of beetle. Larvae often pupate on the host or may drop to the ground to pupate.

Pest monitoring Watch for the larvae or feeding damage (holes) to appear in leaf tissues. Sticky traps may be helpful, especially early in the spring as the adults emerge from hibernation.

Management--cultural control

Select less favored species or cultivars. In some cases, a handheld vacuum may be helpful to remove adults or pupae on the ground.

Management--biological control

For established or native pests, natural enemies such as parasitoids or predators may have some effect. Pheromones or traps may be available for some pests.

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Landscape pests—Leafhopper

Includes *Cicadomorpha* spp.

Pest description and damage Several species of leafhopper may attack ornamental plants. Leafhoppers are slender, delicate insects about 0.125 inch or less in length. They are distinguished by the adults hopping or flying to escape danger, and by the ability of nymphs and adults to run forwards, backwards, or sideways easily. Leafhoppers have piercing-sucking mouthparts that they use to suck the contents out of surface plant cells. Leafhopper feeding damage to leaves includes small white to yellow stipples, yellowing, or leaf curling. Small amounts of this stippling are not injurious to the plants, although sometimes the tips of host plant leaves die and turn brown. Leafhoppers often exude copious amounts of honeydew. Commonly attacked ornamental plants include aster, calendula, gladiolus, dahlia, hollyhock, marigold, rhododendron, rose, and zinnia. Some leafhoppers transmit virus diseases to susceptible crop plants.

Biology and life history Varies with the species. Leafhoppers may overwinter as adults, nymphs, or eggs. There may be two or three generations per year.

Pest monitoring Yellow sticky cards or double-sided tape wrapped around small branches or twigs can be used to monitor for leafhoppers.

Management—cultural control

Use of row cover fabric in early summer can exclude leafhoppers from small shrubs. Yellow sticky traps are attractive to, and entangle, leafhoppers and other insect pests.

Management—biological control

Leafhoppers have many natural enemies, including lady beetles, lacewings, damsel bugs, and spiders. They are also subject to diseases and parasites that keep their numbers low under most circumstances.

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Landscape pests—Leafminer

Insects from several orders including Coleoptera, Lepidoptera, Diptera and Hymenoptera

Pest description and damage Leafminer larvae feed between the upper and lower surfaces of leaves, or under the epidermis of stems or leaf petioles and thus are rather small in size ranging from 0.05 to 0.25 inch in length. Mines may appear as surface blotches, or serpentine (winding) trails. Some leafminers are solitary, others feed gregariously, and the mines may coalesce to form one large mine. For some species, the insect first mines a needle or leaf, but then shifts to tunneling down the petiole, under bark and then enter bud or stem tissues. Larval identification is based on host, type of mine, and the pattern of the frass within the mine. To get a positive identification, it may be necessary to rear some to the adult stage and send them to a taxonomist specializing in that order or group. The damage that the leafminers do is variable and ranges from minor cosmetic damage to total defoliation. There are several orders of insects that have developed the leaf mining lifestyle; control products may vary based on the order of

insects causing the mines.

- Beetle and weevil leafminers include some flat-headed borers, weevils, and leaf beetles.
- Fly leafminers are generally maggot-shaped without a head capsule. Examples include columbine leafminer, holly leafminer and boxwood leafminer.
- Moth leafminers have a distinct head capsule and are commonly found on madrona, including the serpentine and madrona blotch miner, as well as laburnum leafminer, and tentiform leafminers.
- Sawfly leafminers include the elm leaf miner, birch leafminer and alder leafminer.

Biology and life history Mines are often scattered and the leafminers controlled by parasitoids, so leafminers are usually inconsequential to plant health. Occasionally plants become heavily infested, but the plants generally recover. Other leaf miners have two to five generations in a year. Most adults emerge from soil and lay eggs in spring, although some may winter over as larvae in the mine.

Pest monitoring Watch for the adults or the occurrence of the first mines early in the spring as the leaves unfold. Scouting for damage is most critical for leafminers with multiple generations. If early leaf mining activity is minimal, no action is needed, but the plants should be inspected when the next generation is due again. Pheromone traps developed for some leafminers will help determine if a pesticide will be needed. In the case of the elm leafminer, there is a degree day model for predicting egg-laying by adult sawflies.

Management—cultural control

Low numbers of leafminers provide food for the parasitoids that, in turn, keep number of mines low. Handpick and remove mined leaves or squish larvae within mines. Select cultivars that are less susceptible to leafminers. There is evidence that leafminers thrive when plants are stressed, so ensure that landscape plants are planted in the right place and receive water adequate for their needs.

Management—biological control

Many leafminers, even those that occasionally build to large populations, have natural enemies, such as parasitoids, that attack them. Often, about the time damage is intolerable, parasitoids readily find prey in which to lay eggs and by the next generation the leafminer population collapses. Healthy plants can recover from heavy defoliation. A plant under heavy attack will "dump" its leaves by forming a premature abscission layer dropping the leaf from the plant. The leafminer will perish unless it is already nearing pupation. Parasitoids may be seen in or on the leaf mining larvae.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

For more information

Buss, E. A. 2006. Leafminers on Ornamental Plants. University of Florida, IFAS Extension, Publication ENY-326 (http://ufdcimages.uflib.ufl.edu/IR/00/00/28/84/00001/MG00600.pdf)

Byers, J.A. 2006. Leaf-mining insects. Chemical Ecology. (http://www.chemical-ecology.net/insects/leafmine.htm)

Landscape pests—Leafroller and leaftier

Numerous species

Pest description and damage There are many species of moth larvae, including leafrollers and leaftiers, that roll, tie or fold together leaves of ornamental trees, shrubs and other perennials. Leafrollers, when found on native species such as willow, cottonwood, poplar and alder, rarely warrant control since damage is usually cosmetic and short-lived. Mature larvae range between 0.75 to 1.0 inch long. The leafrolling pests can be divided into single-generation moths, such as the fruit tree leafroller and the European leafroller, and two-generation moths, such as the oblique-banded leafroller and three-lined leafroller. The larvae are mostly green or brown caterpillars with a light brown to black head. Some are noted for their violent backward wriggling – a means of escape. Newly hatched larvae also may work into blossoms and damage developing fruit, which then abort and fall off the plant. The larvae web the leaves and flowers together beginning in late April, and then feed on the developing fruit or flowers. Feeding on the growing points of young plants can promote undesirable branching. Larvae also feed on the surface of ornamental fruit or berries. Adults are rarely encountered but have distinctive bands or mottling on the wings. Leaftiers are similar in appearance, although larvae are up to 0.5 inch long, dirty white, with a brownish head.

See also

Oblique-banded leafroller

Carnation tortrix

Biology and life history The single generation leafrollers overwinter as egg masses on twigs and branches. Eggs hatch in spring as buds are opening and continue to hatch until petal fall. The larvae feed for four to six weeks, then pupate in the rolled leaves and emerge as moths in early summer. The overwintering eggs are laid in July. Two-generation leafrollers overwinter as immature larvae under the bark on scaffold branches of a variety of host plants. Larvae may feed during warm periods in winter but are most active in spring with onset of new growth. They feed for several weeks, and then pupate in rolled leaves. Adult moths emerge in late April–May and lay eggs for the next generation. This next generation hatches in early summer and does the most damage.

Pest monitoring Start sampling for leafrollers in mid-April. Examine the new spring leaf growth and terminal clusters for tightly rolled leaves and

feeding damage. Look for light-colored clusters of eggs in patches, laid in rows like fish scales, on the bark. Pheromone traps are useful for monitoring adult emergence.

Management—cultural control

Hand-pick rolled leaves containing larvae or pupae. Removal of overwintering sites, such as rolled leaves on the ground or plastered to tree trunks, can reduce next year's population. Very low temperatures in winter significantly reduce the population of overwintering larvae.

Management—biological control

Spiders and parasitic wasps, as well as predators, like the brown lacewing, greatly reduce leafroller populations throughout the year. There are ichneumonid wasps with special adaptations for parasitizing leafrollers.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

For more information

Bentley W. J. 2010. Leafrollers on Ornamental and Fruit Trees. UC Statewide IPM Program, University of California, Davis (http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7473.html)

Brunner, J. 1993. Leafrollers: Pandemis leafroller, oblique-banded leafroller, fruit tree leafroller, and European leafroller (treefruit.wsu.edu/crop-protection/opm/leafrollers/

Landscape pests—Mealybug

Order Hemiptera: Family Pseudococcidae

Pest description and damage Mealybugs are small (less than 0.125 inch) oblong insects that are often dusted with a coarse white flour-like substance or powdery wax. The insect body color under the white wax may vary from yellowish or clear to pink, even striped, depending on species. They may have long or short filaments on the hind end and/or around the sides. Some species are completely covered with clear filaments like fiberglass. Mealybugs are commonly encountered in greenhouses and houseplants but do occur in landscape plantings. Inspect newly purchased plantings for mealybugs hiding in branch angles, or even tucked in buds. Infested plants may look chlorotic, stunted, or have tightly curled leaves. Plants may wilt or die before natural enemies can gain affect control. Mealybugs may feed on various plant parts, some species even feed on root hairs and roots. Inspect wilting perennials above and below the soil surface for traces of mealybugs.

Biology and life cycle This insect has a quick turn-around and can grow from egg to adult in as little as two months under the right conditions. The duration of the life cycle may fluctuate with higher or lower temperatures and should be considered before pesticide applications. Hosts include foliage of greenhouse plants, herbaceous shrubs and perennials, grapes, fruit trees and some landscape trees.

Pest monitoring Mealybugs suck plant sap, and then excrete the excess sugars and water that become a nutritious substrate for sooty mold fungi. Look for shiny, sticky, honeydew or sooty mold, as well as the presence of natural enemies or ants.

Management—cultural control

Remove mealybugs by gloved hand or use Q-tips to scrape them off. Control ants that defend and move mealybugs around or remove heavily infested and damaged twigs. Ensure good cultural care of the plants.

Management—biological control

There are several predators and parasitoids that prey on these pests and some, like the mealybug destroyer (*Cryptolaemus montrouzieri*), can be purchased and released. The larvae of this beetle are covered in wax. Selection of pesticides that are less toxic to these beneficial insects is advisable.

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

For more information

Osborne, L.S. 2010. "*Mealybugs."* Mid-Florida Research and Extension Center (https://mrec.ifas.ufl.edu/lso/Mealybugs.htm)

Landscape pests—Psylla

Includes many species in the family Psyllidae

Pest description and damage Psylla (or jumping plant lice) are soft-bodied, sucking insects which can produce copious honeydew, or form pseudo-galls. Adult psyllids look like a cross between an aphid and a cicada, about 0.1 inch long and an ability to jump and fly away. Their wings are held roof-like over their body. Adult female psylla attach eggs to the host plant by a small "handlebar". Immature psyllids are oval, flat and scale-like, with conspicuous wing buds, and sometimes with a waxy fringe and/or red eyes. They often live in colonies of mixed life stages. They are closely related to aphids and scale. There are two groups of psyllids: free-living psyllids and lerps (specialized psylla that live under structures of crystallized

honeydew). Free-living and lerp psylla are fairly host specific, and attack only one host from which they get their common name: e.g., boxwood psylla, laurel psylla, hawthorn psylla, and pear psylla are the most common in landscapes. Eucalyptus is host to many species of psyllid.

Biology and life history Life cycles vary with the species. They have incomplete metamorphosis consisting of eggs, nymphs and adults all feeding together. Females can lay between 45 and 700 eggs depending on the species. The nymphs molt five times before becoming an adult. At each molt, the wing buds become more visible. Damage varies with the species. Some species cause pseudo-galls, leaf distortion, leaf color change from red to brown, and abundant honeydew on which sooty mold can grow and defoliation, while others (lerps) live under a covering of crystalized honeydew for protection. There can be one or many generations per year. Psylla populations may be high in one year and nearly non-existent the next.

Pest monitoring Adult psylla and lerps and their natural enemies are attracted to yellow sticky cards. The proportion of pest psyllids to beneficial insects may govern whether pesticides are applied. Branches may also be struck and jarred to dislodge psyllids onto a beating sheet. Also, look for the presence of honeydew or other sugary materials.

Management—cultural control

Psyllids and lerps favor new succulent plant growth. Avoid excess watering, fertilizing, or shearing as these practices promote new growth. Avoid using plants known to have serious psylla problems.

Management—biological control

There are many natural enemies of psyllids and lerps including minute pirate bugs and other predaceous bugs, green and brown lacewings, ladybeetle adults and larvae, and parasitic wasps. Since these can be very effective controls, it is important that any pesticides that are applied are less toxic to beneficials.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

Paine, T.D. and S.H. Dreistadt. 2007. Pests in garden and landscapes: psyllids. University of California, UC--IPM (http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7423.html)

Landscape pests—Root weevil

Numerous species

Pest description and damage Adult weevils are between 0.2- to 0.25-inch-long dark beetles with a snout (rostrum) and elbowed antennae. They cannot fly, so distribution is through migration or movement of infested plants, soil, or debris. The adults of most of the species are all females and capable of laying eggs. They are slow moving and not confused with swifter predacious ground beetles. Frequently adults cause the most conspicuous damage. Adult weevils are night feeders that mostly remain in the soil or in debris at the base of the plant during the day, then climb up to feed on leaves at night. Look for ragged notches on the edges of leaves, or flower petals. Twigs of plants may die beyond where weevils have girdled the twig (salal, rockrose, yew, juniper, etc.). Larvae, found around roots, are C-shaped, legless, and white, or slightly reddish, with tan heads, up to 0.5 inch in size. The larvae of root weevils are quite similar in appearance and habits of feeding on root hairs, larger roots, and root crown. Check the base of unthrifty shrubs for symptoms of girdling by larvae.

Biology and life history Adult root weevils are present in every month of the year in mild climates. Most species have adults that are abundant from May through September. Larvae of these species overwinter in the soil around the roots. Adults of other species emerge in late summer and may be active through the winter and very early in spring in milder climates. The larvae of the fall emerging species are likely to be present during the summer months. There is only one generation per year.

Pest monitoring Observe leaves for fresh notching in early spring and continue throughout the season. Start with visual inspection of damaged plants by day, and then concentrate nocturnal flashlight searches, just after dusk, in those areas. At night, weevils can be dislodged onto a beating sheet, or pizza box, or captured in pitfall traps. Several newly developed traps for trapping adult root weevils are available as a monitoring tool. Inspect unthrifty plants for missing roots, root hairs or for small white, C-shaped grubs.

Management—cultural control

Root weevils are inconsistent in their damage to landscape plants: there appear to be sun/shade influences, host, and cultivar preferences, based on physical and chemical characteristics of plant genera, species, and cultivars. Different plant cultivars may be particularly susceptible or relatively resistant to root weevils. Cultivation of the soil in April and May can eliminate overwintering larvae before planting. Use a cereal cover crop to disrupt weevil numbers, as small grains are not a recorded host for root weevils. Hand-pick adults when found.

Management—biological control

At least two species of parasitic tachinid flies and one braconid wasp have been reared from some species of root weevils. Good control was obtained by placing shredded oak leaves under plants to encourage ground foraging birds. Beneficial nematodes have shown some effectiveness in controlling larvae when applied as a drench as the label directs. Place beneficial parasitic nematodes in the root zone where weevil larvae are; the soil must be moist and the soil temperature above 55°F. Nematodes are available at some garden and nursery stores and through mail order.

Management—chemical control

See Tables 2 and 5 in:
Chemical Control of Landscape Pests

Landscape pests—Sawfly

Several families in the Order Hymenoptera

Pest description and damage Sawflies are members of the Symphyta (horntails and sawflies), a subgroup of the Hymenoptera (ants, bees and wasps). Most sawfly species of concern in home landscapes are small (0.2 to 0.6inch long), black, slow-flying insects that swarm in considerable numbers around host plants in the sun, but the adults do not harm plants. These larvae are caterpillars that are fairly host specific and many get their name from the host plant (i.e., willow sawfly). Some caterpillars feed gregariously along the edges of leaves. There are solitary feeders that chew a hole in a leaf and literally march around feeding inside the hole as they walk. Sawflies differ from moth and butterfly caterpillars in that they have seven or more pairs of prolegs, and many carry their hind end curled back over the body in the shape of an "S". Many sawfly larvae are often quite visible, while others match the edge of the leaf so closely that they seem invisible. There are also sawflies that bore into fruit and wood as well as those that mine leaves or live within plant galls. Adult female sawflies have a small saw-like ovipositor that used to insert eggs into leaf or stem tissue. Eggs, inserted into small slits in leaves, are visible as little raised welts or blisters. Some members are called slugs because they are covered in a slime that protects the larva. These slug-like caterpillars feed on and skeletonize leaves by removing the surface leafy tissues and leaving behind leafless stems with only the petiole and midrib remaining.

Biology and life cycle Sawflies have complete metamorphosis (egg, larva, pupa, and adult). Adults are the mobile stage for dispersing and meeting mates. Often the larvae eat fast and drop to the soil before they are noticed. There may be one to five or more generations in a season. Most species of sawflies overwinter as pupae in soil.

Pest monitoring **Use** yellow sticky traps to monitor adult sawflies. Watch for the appearance of the eggs clustered in little "pita pocket" slits in the leaves or for droppings on underlying leaves. Look for the gregarious larvae lining the leaf edge, or leaf damage along the margin. Leaves, chewed so thoroughly that only the midribs remain, are diagnostic for sawfly damage. Watch for future generations.

Management—cultural control

Pick off larvae from woody plants or hose them off with a strong stream of water.

Management—biological control

Common predators include general bug predators.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

Hahn, J. and J. Llyod. 2018. Sawflies. University of Minnesota Extension (https://extension.umn.edu/yard-and-garden-insects/sawflies)

Landscape pests—Scale insect

Order Hemiptera: Families Coccidae, Diaspididae and others

Pest description and damage Scale insects are common on many ornamental trees and shrubs, groundcovers, and herbaceous plants. Adult female scales live under a shell-like covering that resemble "volcanoes," "barnacles," "hemispherical bumps," "cotton puffs," "oysters" or may appear to be flat, soft and naked, with various dull colors and markings. They are found attached along the branches, twigs, leaves, needles or even fruit. Most scale insects are from 0.062 to 0.25 inch long. These insects have piercing-sucking mouthparts that they inject into plant tissues to feed on plant juices. Occasionally, large populations of scale can devitalize plants and retard growth, as well as discolor foliage and underlying woody tissues. Severe infestations can kill twigs. In many cases, a large quantity of honeydew produced makes leaves and fruit shiny and sticky. Honeydew can collect on decks, lawn chairs and other landscape surfaces and become an intolerable nuisance to homeowners. Sooty mold fungus may grow on the honeydew giving the plants a dirty, sooty appearance.

Biology and life history The life history varies with species, so accurate species identification is needed. Generally, scale insects overwinter as eggs concealed beneath the female parent's scale, or as immature scale on twigs and branches. Scale insects that overwinter as immatures resume feeding in the spring, and adults lay eggs later in spring. When scale overwinter as eggs under the protective scale, they hatch from spring to late June. Young scales are called "crawlers." The crawlers are highly mobile and disperse through the foliage to find a new feeding site. Occasionally, these crawlers can be dispersed from plant to a new host plant by wind or air currents, rain, birds, irrigation water, or by the movement of people and machinery. When they find a suitable site, many insert their mouthparts, molt, and lose their legs, and become non-mobile. They then form the wax or cottony scale that conceals them. Scales feeding on the leaves of deciduous plants will move back onto the branches in late summer or fall. Adult males may be winged or wingless and seek out the non-mobile adult females. There will be one or two generations per year for most scale species.

Pest monitoring Inspect twigs and tissues during the dormant season for scale insects. Pay attention to sickly plants and those with low vigor. The scale crawler stage is most susceptible to chemical control measures. Monitor the movement of newly hatched crawlers by wrapping a piece of sticky tape around an infested branch with the sticky side out. The crawlers are very small and best observed with a 10X magnifying glass. Check beneath scale for

live females or eggs, or for predator mites or parasitoid wasp grubs. Fluff beneath scale could indicate parasitoid activity or that the eggs have hatched. Holes in a scale insect covering indicate that parasitoids have emerged.

Management—cultural control

Scrape scale insects off plants by hand with fingernail or toothbrush. Prune off major infestations in trees and shrubs if possible. Apply tape, sticky side out or use a similar adhesive near infestations of adult scale to intercept and catch the crawler stage. Water landscape plants and trees properly, as drought-stressed plants are more susceptible to scale insects. Avoid excessive nitrogen applications as this encourages growth in scale insect populations. Generally, apply pesticide products to target the vulnerable crawler stage before the scale covering is formed.

Management—biological control

The waxy scale cover of these insects tends to conceal and protect them from generalized predators and from some pesticides. Numerous predators specialize in feeding on these protected scale insects including birds, lady beetle adults and larvae, mites and green lacewing larvae. Numerous species of minute wasps lay eggs in and parasitize scale insects. Biological control may prevent significant scale infestations. Avoid broad-spectrum insecticide applications that would disrupt these natural enemy populations allowing the scale to reproduce.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Landscape pests—Spider mite

Spruce spider mite (*Oligonychus ununguis*)
Twospotted spider mite (*Tetranycus urticae*)

Pest description and damage Several species of spider mites can cause damage to deciduous, evergreen, and coniferous ornamental plants. Appearance of these mites varies with the species, although all are 0.02 inch or smaller in length. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Twospotted spider mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants may be covered with fine silk webbing at branch axils or leaf mid-veins, small plants may be engulfed in webbing under heavy infestations.

Biology and life history Most mite species share a similar life cycle. Most species overwinter as eggs on host plants, although some may overwinter as adult females. Mites become active in the spring. There may be eight to ten overlapping generations per year.

Pest monitoring Observe the leaves for mites and/or mite eggs, stippling, or webbing and check for the presence of predator mites. Sufficient biological control is achieved by midsummer. Using a stick, hit a branch over white paper to *see* if mites (moving dust specks) or natural enemies are present.

Management—biological control

The keys to the successful use of predator mites are identifying the appropriate mite for the pest mite to be controlled, good scouting, and releasing the mites at the proper threshold. The predator mite *Neoseiulus fallacis* successfully controls many mite species including bamboo and spider mites if broad-spectrum insecticide applications are avoided. If one mite is found per five leaves inspected, it is time to release the predatory mites (check with supplier). Without a rigorous scouting program, these low levels of pests are not noticed. *N. fallacis* requires 80% humidity, and is commonly found in the canopy of plants grown in the Northwest. Insect predators of mites include lady beetle adults and larvae, lacewing larvae, thrips, and minute pirate bugs. Hold a clipboard with white paper under branches, then give the branch a sharp rap with a stick to dislodge mites. The smaller, darker specks on the paper that begin to walk away are mites, but it may be useful to differentiate between pest and predator mites under a hand lens or microscope.

Management—cultural control

Severe infestations are treated by removing infested leaves on plants (where practical) and burning or otherwise disposing of the foliage. Then the remaining foliage is treated more effectively for mites. This treatment may be the only practical solution for heavily infested sites, where chemical application presents difficulties (proximity to surface water, food crops or on indoor plants). Heavy rain and cold weather suppress mite numbers. Hot dry conditions seem to increase the numbers. Suppression of broadleaf weeds such as mallow, bindweed, white clover, and knotweed or grasses with cultivation may reduce mite numbers. Wash mites from the tree with a strong stream of water. This dislodges dust and dirt and favors an increase in mite numbers. Water trees properly, as drought-stressed trees are more susceptible to mite damage. Avoid excessive nitrogen applications, as this encourages mites. Since mites thrive under hot dry conditions, increasing humidity with periodic short bursts of water to foliage may help. Monitor before and after to evaluate the effectiveness of management strategies.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Landscape pests—Spittlebug and froghopper

Order Hemiptera: Family Cercopidae

Pest description and damage Spittlebugs are first noticed in late spring within white frothy masses of bubbles on grasses, herbaceous plants,

shrubs, and conifers. Small nymphs of the spittlebug are mostly greenish with conspicuous red eyes; different species may have different coloration. In most landscape gardens, there may be some wrinkling of the leaf or stem where the young spittlebugs are feeding. Spittlebug adults range from 0.2 to 0.3 inch long. Froghopper adults are found later in spring and summer. They look like leafhopper adults, but froghoppers are shorter and wider. One diagnostic feature is that the hind legs of froghoppers lack spines. Damage from adults is slight.

Biology and life cycle Eggs are laid in late summer in the axils of plants and hatch in spring. Young spittlebugs begin to suck plant juices and excrete the liquids along with air resulting in a froth of bubbles covering the bug. The spittle protects the nymphs from drying out and from predators and parasitoids. Adults emerge in mid- to late-summer.

Pest monitoring The obvious indicator is the white frothy "spittle" especially on field grasses and flowers. Most people object more to the spittle than the spittlebug or the slight puckering of leaves.

Management—cultural control

It is easy to hose off the plants if the spittle becomes too objectionable. Most spittlebugs in the PNW cause little damage to plants and can be ignored.

Management—biological control

Several wasp species have been reported to parasitize spittlebug eggs, as well as a big-headed fly (Pipunculidae) that can cause 50-60% parasitism in adults.

Management—chemical control

Not recommended for home landscapes

Landscape pests—Stink bug

Includes numerous species in the family Pentatomidae

Pest description and damage Stink bugs are true bugs with a distinctive, triangular area (scutellum) that extends between the hemi-elytra or forewings of stink bugs. Stink bug adult size varies from 0.35- to 0.75-inch long. The forewings are partly leathery at the base and partly membranous toward the tip. Stink bugs have straw-like sucking mouthparts, through which they can inject a digestive fluid and suck back the digested contents. Stink bugs have incomplete metamorphosis (eggs, adults, and nymphs that look like adults without wings). Stink bugs are found on weeds and native and ornamental plants that have abundant seeds pods, berries, or other fruit; also, they can feed on plant cells or sap. Some stink bugs are predators on other insects, including other stink bugs. Generally, stink bugs do little damage to landscape plants, but they can harm the fruit, berries and pods. They are common on weed pods, raspberries, and berries. The brown marmorated stink bug (BMSB) is a newly introduced invasive species that has proliferated and become a major pest of all plants where it has established.

Biology and life history Stink bugs lay barrel-shaped eggs in clusters on or near food plants or seeds. The young larvae are brightly colored, very rounded, and they cluster on the eggs when they first hatch. They change to their adult colors as they molt toward maturity. Then they disperse to feed on nearby fruit or seeds. BMSB seeks shelter in homes or protected places in the landscapes, and they are moved around the country with household belongings, so they have spread rapidly across the US. The first detection of this Asian invasive species in the PNW was in Oregon in 2004 and it is now a major pest here. BMSB is found in crops in WA and ID, but only in small numbers.

Pest monitoring A thorough list of monitoring tools, attract-and-kill devices, natural enemies, and organic options for control can be found under "managing BMSB" at http://stopbsmb.org.

Management—cultural control

Reduce overwintering sites in buildings by caulking and filling cracks to potential entry areas. Remove weeds with abundant seed pods, especially those close to buildings.

Management—biological control

Stink bugs have natural enemies, including predaceous stink bugs. Some native parasitoids and predators may be able to adapt to BMSB and there is promise in augmenting an egg-parasitic Asian wasp known as the Samurai wasp (*Trissoclus japonicus*).

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Landscape pests—Thrips

Includes *Frankliniella* spp.

Pest description and damage Several species of thrips cause injury to several woody ornamentals. Thrips are very tiny, skinny insects, less than 0.05 inch long. Color varies from reddish yellow to mid-dark brown. Winter populations are darker in color. Thrips have rasping mouthparts and damage plants by sucking out the contents of plant cells and depositing tiny specks of honeydew. Damaged leaves look bleached and/or silvered and speckled with shiny "tar-spot" excreted by thrips during feeding. They can damage flower buds, opened flowers, leaf buds and leaves. Damage to flowers appears as streaking in the blossoms, there may be yellow pollen on petals where thrips were feeding on the stamens. Flower life may be reduced. Damage to foliage is particularly noticeable if it occurs in the bud stage. In this case, leaves typically are distorted and may be flecked with thrips, tar-spots or

feeding damage. Thrips are particularly common on gladiolas and dandelion flowers.

Biology and life history In spring, the adults fly to host plants and enter flower blossoms to feed on pollen, nectar, and flower parts. Eggs are laid in the flower parts, and the immatures emerge to feed. Several generations pass each summer, and adults may feed on adjacent flowering plants as well. Thrips also migrate into landscapes and greenhouses when adjacent infested fields are mowed.

Pest monitoring Watch for small specks of glistening frass on the surface of lilac and privet leaves; thrips look like tiny, wood slivers gliding about leaves or among blossoms. Thrips feed on pollen and may scatter pollen on the petals.

Management—cultural control

Cold, wet weather during bloom reduces thrips damage. Hosing plants with water in the morning may discourage thrips.

Management—biological control

Predatory thrips species and mites can reduce populations on host plants while parasitic nematodes can kill off thrips that move to the soil to pupate.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

Dreistadt, S.H., P.A. Phillips and C.A. O'Donnell. 2007. Thrips. (https://ipm.ucanr.edu/PMG/PESTNOTES/pn7429.html)

Landscape pests—Whitefly

Order Hemiptera: Family Aleyrodidae

Pest description and damage Whiteflies are tiny (less than 0.05 inch long), pure white, moth-like sucking insects that feed and lay eggs on the undersides of leaves. The nymphs appear as translucent yellow flattened elliptical discs and are mobile. As the nymphs reach the later instars, they become immobile and appear as thickened elliptical raised discs. Male and female whitefly adults emerge to mate and lay eggs. Tiny black eggs are laid in small circles, half circles or as scattered singles. Small circles that appear dusted with a white powder may be noted. Damage varies by species but, in general, whiteflies suck plant sap from the phloem or plant cells. Leaves may turn yellow or dry and fall, or leaves are covered by honeydew colonized by sooty mold fungus. Some whiteflies can transmit viruses. Plant hosts include rhododendron and azalea, Indian plum, Ceanothus, fuchsia, and many other plants. The presence of whiteflies on the undersides of evergreen broadleaf plants in fall and winter may not be predictive of summer problems. High populations of whiteflies can severely damage fuchsias.

Biology and life cycle This insect has four instars: nearly invisible 1st instar, yellowish flat 2nd and 3rd instars and the 4th thickened instar before molting to the adult stage. In warm weather, populations can build quickly to cause considerable damage. Often, adult whiteflies overwinter on the host and emerge the following spring.

Pest monitoring Shake plants and search for flying adult whiteflies. If the adult whiteflies are present, check the undersides of leaves to verify young, feeding stages are present, or check for honeydew and sooty mold on the lower leaves or ground beneath the plant canopy. Determine whether the level of damage is worth control efforts.

Management—cultural control

Keep plants healthy and watered according to their needs. Whitefly populations increase with high nitrogen levels, so do not over-fertilize plants. Wash plants with a gentle stream of water directed to the underside of plants or disturb foliage and vacuum adults. Prune back and encourage host plant regrowth. A combination of disturbing the foliage, vacuuming flying adults and using sticky yellow cards attractive to whiteflies provides some measure of control, but stay vigilant.

Management—biological control

The most noted biological control is *Encarsia formosa*, and there are several *Encarsia* species that can be purchased for release. Shipments include pupae encrusted on small cards that are clipped onto the host plant foliage. Make sure to put one card in a jar to observe hatch date and to determine if parasitoids are alive. Other predators and parasitoids are also active and together they often bring high populations back into check.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

Flint, M.L. 2002. Whiteflies. University of California (https://ipm.ucanr.edu/PMG/PESTNOTES/pn7401.html#TABLE1)

Landscape pests—Woodborer

Several orders including:
Order Coleoptera: longhorned beetle*, Anoplophora glabripennis* (roundheaded borer), metallic buprestid (flatheaded borer);
Order Lepidoptera: clearwing moth, carpenterworm, *Prionoxystus robiniae*

Pest description and damage Adult buprestid woodborers are oblong beetles, usually less than one inch long, and often with an iridescent sheen to their wing covers. Adults may feed on flowers or pollen. Adult longhorned woodborers are long, slender beetles ranging from 0.5 to over 4 inches long, some with antennae longer than the beetle itself. They may have colorful markings and be found on flowers where they graze on the pollen. Both families of beetles are attracted to dying and dead trees. Hence, damage is secondary to the decline of the host, as woodborers help breakdown the wood. These borers, as larvae or grubs, may spend several years feeding within the wood before emerging as adult beetles. Weevils such as the poplar-and-willow borer can be destructive to willow and poplars. Willow trees are weakened severely by the internal galleries made by the larvae as they tunnel and feed within the wood. Many of the borers allow fungus to enter when the adult lays eggs, further assisting decomposition. Lepidopteran woodborers include carpenterworms and clearwing moths whose larvae tunnel and feed in wood as well. Occasionally woodboring adults may emerge from firewood brought indoors. In forestry, these woodborers are serious pests as they can cause considerable damage to timber waiting to be milled. Larvae damage the wood by boring and feeding through the wood and leaving large rounded or flattened holes as they exit the host. This damage destroys the integrity of the wood and reduces its usefulness and value as lumber.

Biology and life history The moment a tree is cut, it is an attractive food source for these insects. Depending on time of year and temperature, these insects will arrive within hours of a felled and dead/dying tree. Life cycles are variable with the species of insect. Some insects spend many years inside the wood environment. The golden buprestid may feed for up to fifteen years in wood. Adult emergence occurs when the larvae have eaten enough nutrients to develop fully and can transform to the pupal stage. The quality of wood influences that timing. In some cases, healthy trees are attacked, but usually trees are in a stressed or weakened state and unable to defend themselves against the insects.

Pest monitoring Look for cracks or irregularities in bark, watersoaked areas, holes with running sap or sawdust frass oozing out. The base of a tree may be covered with granular sawdust mixed with sap. Limb breakages may occur because of weakened wood strength. To determine which species of insects are attacking the trees, the simplest method is to place sections of infested wood, or branches, in a garbage can modified to be an emergence chamber. Cut holes the size of pint canning jars so that the jar ring can be pushed into the hole. Then the jar is screwed in place. When the insects emerge, they usually go to the light in the jar and trapped there until the jar is removed and the insects identified. This method also traps parasitoids that may have been living in, on, or with the pest.

Management—cultural control

Remove the bark to reduce egg-laying sites for those species that lay eggs in bark crevices. Remove dead and dying wood so populations do not build up and spread to healthier trees. Keep trees watered during drought and reduce soil compaction by foot traffic and autos driving beneath the canopy of trees. Whitewash trunks of young trees to prevent sunburn and reduce potential hazard of attack from flathead borers. Check buried roots on unthrifty perennials for damage due to construction, landscaping and bulldozing.

Management—biological control

Several predators and parasitoids can reduce survival of woodborers. Pheromone traps may be deployed to draw in woodborers adults. The larvae and adults also serve as food to birds, raccoons and other animals.

Management—chemical control

Not recommended for home landscapes. Minimize the use of broad-ranged pesticides that may kill off beneficial insects.

For more information

Cranshaw, W.S. and D.A. Leatherman. 2006. Shade Tree Borers. Colorado State University 5.530 (https://extension.colostate.edu/topic-areas/insects/shade-tree-borers-5-530/)

Kalisch, J.A. and F.P. Baxendale. 2010. Insect Borers of Shade Trees and Woody Ornamentals. University of Nebraska Extension EC1580 (https://extensionpublications.unl.edu/assets/pdf/ec1580.pdf)

Chemical Control of Landscape Pests

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How to use these tables Choose from the five general types of insect and mite damage to landscape plants. Scan through the column on the left to find the general group of insect/mite identified causing this damage. Then follow the table from left to right to find monitoring, scouting and pesticide management strategies. Biology and management recommendations are provided for specific plant pests are listed is the following section of Hosts and Pests of Landscape Plants. Common pest names often refer to multiple species, and taxonomic groupings, so examples of the species covered under each common name are provided. Occasionally pests sharing a common name may cause several types of damage to landscape plants, so be sure to make sure that you select the table that best fits the damage type. Note that in some cases, damage to a plant may be of no concern to the homeowner.

Home landscape products are those pesticides that can be purchased at local retail stores and can be used without a pesticide license. These products are listed by active ingredient; products based on the same active ingredient may be comparable and effective. Restricted-use products may be used only by applicators with the appropriate pesticide license. For all products, the applicator must review the pesticide label as some products may negatively impact some species of ornamental plants and some products may only be applied to specific areas within the home landscape. In the case of any discrepancy between these recommendations and the product label, ALWAYS follow the product label. Remember pollinators, such as honey bees, are often susceptible to insecticide products. Unless otherwise specified on the label, DO NOT spray insecticides on plants (including weeds as well as garden crops) that are in bloom.

Table 1. Plant damage by sucking pests

This damage type is caused by pests that insert piercing-sucking mouthparts into the above ground plant tissues including stems, buds, petioles, needles and leaves. Often this damage results in plant surface stickiness from honeydew production, surface discoloration (sooty mold, tar spots), low plant vigor, canopy yellowing, leaf stippling, premature leaf drop, leaf and shoot distortion and overall plant stunting.
A few of these pests can vector plant diseases.

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
Adelgid (Hemiptera: Adelgidae) includes: Balsam woolly adelgid Hemlock woolly adelgid Pine bark adelgid	Monitor the crawler stage with double-sided tape. Best spray timing is early spring or near bud break. Most products are contact insecticides and thorough coverage is essential. Systemic products (circulated within the plant's vascular system) are better suited for tall trees and shrubs.	clothianidin [S] sfenvalerate fluvalinate horticultural oils [O] imidacloprid [S] insecticidal soap [O] pyrethrins[O] pyrethroids [P] spinosad [O] thiamethoxam [S]	abamectin acephate acetamiprid [S] azadirachtin[O] carbaryl chlorpyrifos cyantraniliprole dinotefuran[S] spirotetramat
Aphid (Hemiptera: Aphididae) includes: Alder aphid Apple aphid Bamboo aphid Beech blight aphid	Timing critical as many species have complex life cycles that alternate between asexual & sexual reproduction as well as summer and winter plant hosts. Adults, nymphs and winged adults found on succulent plant tissues. Monitor winged adults with yellow sticky traps.	acephate acetamiprid [S] azadirachtin [O] carbaryl clothianidin [S] esfenvalerate	abamectin *Beauveria bassiana* chlorantraniliprole chlorpyrifos cyantraniliprole diazinon

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
Black cherry aphid Black citrus aphid Common birch aphid Foxglove aphid Geranium aphid Giant conifer aphid Giant willow aphid Hop aphid Leafcurl ash aphid Norway maple aphid Pine aphid Potato aphid Rhododendron aphid Rose aphid Sycamore aphid	Scout landscape plants for honeydew and sooty mold. Dormant applications of horticultural oils are effective on managing the non-mobile life stages. Target the rapidly-increasing aphid populations early in the growing season, before leaves curl about and protect aphids from sprays. Most products are contact and thorough coverage is essential. Systemic products (circulated within the plant's vascular system) are better suited for tall trees and shrubs.	fluvalinate horticultural oils [O] imidacloprid [S] insecticidal soaps [O] kaolin clay [O] malathion pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	dimethoate dinotefuran [S] fenpropathrin flupyradifurone *Isaria fumosorosea* lime sulfur/calcium polysulfide [O] methiocarb pyridaben pyriproxyfen spirotetramat tolfenpyrad
Lace Bug (Hemiptera: Tingidae) includes: Azalea lace bug Rhododendron lace bug	Scout landscape plants for yellow leaf stippling Check underside of stippled leaves for varnish-like tar spots, and lace bugs. Damage is most pronounced early to mid-July. Most products are contact and thorough coverage on the underside of foliage is essential.	acephate azadirachtin [O] carbaryl esfenvalerate fluvalinate horticultural oils [O] imidacloprid [S] insecticidal soap [O] kaolin clay [O] malathion pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	abamectin *Beauveria bassiana* [O] chlorpyrifos cyantraniliprole dimethoate dinotefuran [S] fenpropathrin flupyradifurone
Leafhopper (Hemiptera: Cicadellidae) includes: Rose leafhopper	Scout for leaf stippling, honeydew, and tar spots. Monitor adults with yellow sticky traps. Monitor nymphs with double-sided tape wrapped around branches or twigs. Most products are contact and thorough coverage is essential. Systemic products (circulated within the plant's vascular system) are better suited for tall trees and shrubs.	acephate acetamiprid [S] azadirachtin [O] carbaryl clothianidin [S] esfenvalerate fluvalinate horticultural oils [O] imidacloprid [S] indoxicarb insecticidal soap [O] kaolin clay [O] malathion pyrethrins pyrethroids [P] spinosad [O] thiamethoxam [S]	abamectin *Beauveria bassiana* [O] buprofezin chlorpyrifos dimethoate diazinon dinotefuran [S] fenpropathrin flupyradifurone phosmet pyridaben spirotetramat tolfenpyrad
Mealybug (Hemiptera: Pseudococcidae) includes:	Scout for mealybugs; they may be covered with powdery wax. Examine narrow branch angles, leaf petioles, bud scars for mealybugs.	acephate acetamiprid [S] azadirachtin [O]	*Beauveria bassiana* [O] buprofezin chlorpyrifos

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
Grape mealybug **Psyllid** (Hemiptera: Psyllidae) includes: Boxwood psyllid Pear spylla Laurel psylla Hawthorn psylla **Phylloxera** (Hemiptera: Phylloxeridae) includes: Oak phylloxera	Mealybugs and psyllids produce of honeydew as well as crystallized honeydew. Psyllids may cause gall-like structures and leaf distortion on some plant species. Monitor adult psyllids with yellow sticky traps. Best controlled early in the season, to prevent population explosions later in the season. Scout for phylloxera and the damage they cause (yellow spots on leaves) in the spring and early summer. Dormant applications of horticultural oils are effective on managing the non-motile life stages. Most products are contact and thorough coverage is essential. Some products are systemic and are better suited for tall trees and shrubs.	carbaryl clothianidin [S] esfenvalerate fluvalinate horticultural oils [O] imidacloprid [S] insecticidal soap [O] kaolin clay [O] malathion pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	diazinon dimethoate dinotefuran [S] flupyradifurone *Isaria fumosorosea* phosmet pyriproxyfen spirotetramat tolfenpyrad
Scale Insect (Hemiptera: Coccidae) includes: Brown soft scale Cottony cushion scale European fruit lecanium Sycamore scale (Hemiptera: Diaspididae) includes: Black pine leaf scale Holly scale Juniper scale Pine needle scale Oystershell scale Eriococcidae includes: Azalea bark scale European elm scale	Scout for non-mobile stages concealed beneath bumps, cotton balls, barnacles, oyster shells. Double-sided tape, adhesive barriers intercept mobile crawler stage. Mobile stages include the newly hatched crawler stage. Pesticide applications timed to target mobile crawler stage. Most products are contact and thorough coverage is essential. Some products are systemic and are better suited for tall trees and shrubs.	acephate acetamiprid [S] azadirachtin [O] carbaryl clothianidin [S] emamectin benzoate esfenvalerate fluvalinate horticultural oils [O] imidacloprid [S] insecticidal soap [O] malathion pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	abamectin buprofezin chlorpyrifos *Chromobacterium subtsugae* cyantraniliprole diazinon dimethoate dinotefuran [S] flupyradifurone lime sulfur/ calcium polysulfide [O] pyriproxyfen spirotetramat tolfenpyrad
Spider mite (Trombidiformes: Tetranychidae) includes: Bamboo spider mite Brown mite Boxwood spider mite Citrus red mite European red mite Spruce spider mite Two-spotted spider mite False spider mite	Scout for mite feeding damage to the plant foliage; damage includes leaf stippling, leaf bronzing and premature leaf drop. Often a 10- to 20X hand lens is needed to see these mite pests that are often on the underside of the leaf along the midrib. Spider mite webbing may also be detected along the leaf midrib. Many of these products are contact insecticides that target mobile mite stages. Thorough plant coverage with the spray is key to success and often two or more applications may be necessary. Horticultural oils and some insecticides target mite eggs.	acephate azadirachtin [O] esfenvalerate fluvalinate horticultural oils [O] imidacloprid [S] insecticidal soap [O] kaolin clay [O] malathion pyrethrins pyrethroids [P] spinosad [O] sulfur [O] thiamethoxam [S]	abamectin acequinocyl *Beauveria bassiana* [O] bifenazate chlorfenapyr chlorpyrifos clofentezine cyflumetofen diazinon dimethoate etoxazole fenbutatin-oxide fenpropathrin fenpyroximate

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
			hexythiazox *Isaria fumosorosea* [O] lime sulfur/ calcium polysulfide [O] methiocarb propargite pyridaben spiromesifen spirotetramat
Thrips (Thysanoptera: Thripidae) includes: Gladiolus thrips Western flower thrips	Scout the newest tissues of landscape plants for thrips damage, which appears as plant rasping that discolors the surface leaving minute white or ghosting spots. Tap or beat these plant tissues over a dark flat surface to reveal tiny, thin insects that quickly fly or run to escape. The presence of tar spots (frass) may also serve as a sign of thrips activity. Most chemical products are contact insecticides that target thrips larvae or adults and timing of sprays coincides with their presence. Thorough plant coverage with the spray is key to success.	acephate acetamiprid [S] azadirachtin [O] carbaryl clothianidin [S] esfenvalerate fluvalinate horticultural oils [O] imidacloprid [S] insecticidal soap [O] kaolin clay [O] malathion pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	abamectin *Beauveria bassiana* [O] chlorfenapyr chlorpyrifos cyantraniliprole diazinon dimethoate dinotefuron [S] fenpropathrin flupyradifurone *Isaria fumosorosea* [O] methiocarb novaluron spirotetramat tolfenpyrad
True Bug (Hemiptera: numerous families) includes: Honeylocust plant bug Stink bug Western boxelder bug	Scout for the presence of these bugs in landscape plants. Damage to the plant's reproductive structures reduce seed viability. These insects are rarely considered landscape plant pests that require treatment to protect overall health. Often these are nuisance pest congregate in large numbers on homes.	acetamiprid [S] carbaryl esfenvalerate imidacloprid [S] fluvalinate malathion pyrethrins [O] pyrethroids [P]	acephate *Beauveria bassiana* [O] chlorpyrifos dinotefuran [S] fipronil novaluron thiamethoxam [S]
Whitefly (Hemiptera: Aleyrodidae) includes: Glasshouse whitefly Rhododendron whitefly	Infected leaves may start to turn yellow appear wilted, or prematurely drop from plant. Look for honeydew and sooty molds. Clouds of adults fly away from infested plants when approached. Monitor adults with yellow sticky traps. Most products are contact and thorough coverage is essential. Some products are systemic and are better suited for tall trees and shrubs.	acephate acetamiprid [S] azadirachtin [O] clothianidin [S] esfenvalerate fluvalinate horticultural oils [O] imidacloprid [S] insecticidal soap [O] kaolin clay [O] malathion pyrethrins [O]	abamectin *Beauveria bassiana* [O] buprofezin carbaryl chlorpyrifos *Chromobacterium subtsugae* cyantraniliprole diazinon dimethoate dinotefuran [S] etoxazole

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
		pyrethroids [P] spinosad [O] thiamethoxam [S]	fenazaquin fenpropathrin fenpyroximate flupyradifurone *Isaria fumosorosea* novaluron pymetrozine pyridaben pyriproxyfen spiromesifen spirotetramat tolfenpyrad

O = Some formulations may be OMRI-listed for organic use.

P = The synthetic pyrethroids are broad-spectrum insecticides that include products with the active ingredients including bifenthrin, cyhalothrin, cyfluthrin, cypermethrin, deltamethrin and permethrin.

S = Systemic products that circulate within the plant's vascular system.

Table 2. Plant damage by tissue-feeding pests

Damage is caused by pests with chewing mouthparts that feed on primarily leaf, bud and flower and fruit tissues reducing plant canopy in the form of leaf holes, leaf rolling, skeletonization, and defoliation. While this damage is often considered cosmetic and plants can regenerate these tissues, repeated damage over multiple seasons can impact overall plant health.

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
Tent Caterpillar (Lepidoptera: Erebidae) includes: Douglas-fir tussock moth Fall webworm Spruce webworm (Lepidoptera: Gelechiidae) includes: Cotoneaster webworm (Lepidoptera: Lasiocompidae) includes: Forest tent caterpillar Western tent caterpillar	Scout for the webbing and silk tents that can contain numerous caterpillars. Scout the foliage of landscape plants for signs of chewing insect damage, or in extreme cases, plant defoliation. Most chemical products are contact insecticides and target the caterpillars as they feed on foliage outside their webbing or tents. *Bacillus thuringiensis* must be ingested by the caterpillar to be effective. Some products are systemic and are better suited for tall trees and shrubs.	acephate azadirachtin [O] *Bacillus thuringiensis kurstaki* [O] carbaryl clothianidin [S] emamectin benzoate esfenvalerate horticultural oils [O] imidacloprid [S] malathion pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	abamectin *Bacillus thuringiensis aizawai* [O] chlorpyrifos diazinon diflubenzuron indoxacarb methoxyfenozide phosmet spinetoram tebufenozide
Caterpillar (Lepidoptera: Choreutidae) includes: Apple-and-thorn	Scout landscape plants for signs of chewing insect damage including leaves, buds, or flower holes, skeletonization, leaf-rolling, or in extreme cases, plant defoliation.	acephate acetamiprid [S] azadirachtin [O] *Bacillus thuringiensis*	abamectin *Bacillus thuringiensis aizawai/kurstaki* [O] chlorantraniliprole

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
skeletonizer (Lepidoptera: Erebidae) includes: Satin moth Silver-spotted tiger moth (Lepidoptera: Geometeridae) includes: Western oak looper (Lepidoptera: Noctuidae) includes: Black cutworm Large yellow underwing Variegated cutworm (Lepidoptera: Notodontidae) includes: Western redhumped caterpillar (Lepidoptera: Tortricidae) includes: Spruce budworm	Pheromone traps may be available to monitor some adult moth species. Most chemical products are contact insecticides that target the youngest caterpillars and timing of sprays coincides with their presence. Thorough plant coverage with the spray is key to success. *Bacillus thuringiensis* must be ingested by the caterpillars to be effective. Some products are systemic and are better suited for tall trees and shrubs.	*kurstaki* [O] carbaryl clothianidin [S] esfenvalerate fluvalinate horticultural oils [O] imidacloprid [S] kaolin clay malathion pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	chlorfenapyr chlorpyrifos *Chromobacterium subtsugae* [O] cyantraniliprole diflubenzuron indoxacarb methoxyfenozide novaluron
Earwig - (Dermaptera: Forficulidae) includes: European earwig	Scout for damage caused by earwigs; earwigs tend to chew irregular variable-sized hole in plant tissues. Scout for earwig presence and activity at night with a flashlight. Most chemical products are contact insecticides that target earwig populations early in the spring before they reproduce.	azadirachtin [O] carbaryl clothianidin [S] esfenvalerate fluvalinate imidacloprid [S]malathion pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	acephate acetamiprid [S] *Beauveria bassiana* [O] chlorpyrifos fipronil
Grasshopper (Orthoptera: Acrididae) includes: Grasshopper (Orthoptera: Gryllidae) includes: True cricket (Orthoptera: Tettigoniidae) includes: Mormon cricket Katydid	Scout for fresh damage caused by grasshopper and cricket adults and nymphs that appears as general chewing damage to plant leaves, stems and fruit. Scout for the presence of grasshoppers or crickets; since some species have wings and jumping legs, they may take flight as you approach plant. In some regions of the state, these insects periodically become pests when their populations explode, and they deplete preferred hosts in rangelands. Most of these products are contact insecticides that intercept invading pests.	acephate azadirachtin [O] carbaryl imidacloprid [S] esfenvalerate fluvalinate malathion pyrethrins [O] pyrethroids [P] thiamethoxam [S]	chlorpyrifos clothianidin [S] diflubenzuron dimethoate indoxacarb phosmet

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
Leaf feeding beetle (Coleoptera: Chrysomelidae) includes: Alder flea beetle Dogwood flea beetle Elm leaf beetle Lily leaf beetle Viburnum leaf Western spotted cucumber beetle Willow flea beetle	Scout landscape plant foliage for chewing damage in the form of scalloped holes, general leaf holes, and leaf skeletonization. When damage is found examine plant for signs of beetle adult or larvae. Adult flea beetles do jump and may escape detection. Most chemical products are contact insecticides. Timing of sprays coincides with target pest activity/presence. Thorough plant coverage with the spray is key to success. *Bacillus thuringiensis* must be ingested by the beetles to be effective. Some products are systemic and are better suited for tall trees and shrubs.	acetamiprid [S] azadirachtin [O] carbaryl esfenvalerate fluvalinate imidacloprid [S] malathion pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	acephate chlorpyrifos diazinon phosmet
Sawfly (Hymenoptera: Argidae) includes: Birch sawfly (Hymenoptera: Tenthredinidae) includes: Azalea sawfly Birch leafminer Bristly roseslug Curled rose sawfly Dogwood sawfly Elm leafminer European alder leafminer Green alder sawfly Mountain ash sawfly Pear slug Roseslug Striped alder sawfly	Scout landscape plants for signs of chewing damage caused by larvae. Examine fresh damage for the presence of caterpillar-like or slug-like sawfly larvae. Some species of larvae are gregarious while others are solitary. Most chemical products are contact insecticides that target the youngest larvae and timing of sprays coincides with their presence. Thorough plant coverage with the spray is key to success. Some products are systemic and are better suited for tall trees and shrubs.	acephate acetamiprid [S] azadirachtin [O] carbaryl clothianidin [S] esfenvalerate fluvalinate horticultural oils [O] imidacloprid [S] insecticidal soap [O] pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	abamectin chlorpyrifos diazinon dimethoate diflubenzuron dinotefluran[S] indoxacarb malathion phosmet
Weevil (Coleoptera: Curculionidae) Leaf-feeders include: Black vine weevil Clay-colored weevil Douglas-fir twig weevil Lilac root weevil, Obscure root weevil Poplar-and-willow borer Strawberry root weevil Woods weevil Bud (seed)-feeders include:	Scout for damaged foliage with notched leaf margins. Foliar damage is often cosmetic only and rarely impacts overall health of landscape plant. For any unthrifty shrub, tree or plant, search the soil in the plant's root zone for c-shaped weevil grubs. The poplar-and-willow borer larvae feed along plant stems and trunks. Most chemical products are contact insecticides and target the adult weevils before they lay eggs. Timing of sprays coincides with adult weevil	acephate acetamiprid [S] azadirachtin [O] *Bacillus thuringiensis galleriae* [O] carbaryl clothianidin [S] esfenvalerate fluvalinate imidacloprid [S] kaolin clay [O] malathion	*Beauveria bassiana* [O] chlorantraniliprole chlorpyrifos cryolite cyantraniliprole diazinon diflubenzuron dimethoate dinotefuran [S] indoxacarb novaluron phosmet

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
Hollyhock weevil Rose curculio	activity/presence. Adult activity can be done at night by jarring and capturing adults. Adults of most species are active in late May and June. Scout for the adult beetles as they feed on and oviposit in buds. Rose curculio emerge in early spring. Hollyhock weevil is active in July and August. Damage is limited to flower buds and reproduction and does not affect the overall health of the infested plants.	pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	trichlorfon

O = Some formulations may be OMRI-listed for organic use.

P = The synthetic pyrethroids are broad-spectrum insecticides that include products with the active ingredients including bifenthrin, cyhalothrin, cyfluthrin, cypermethrin, deltamethrin and permethrin.

S = Systemic products that circulate within the plant's vascular system.

Table 3. Landscape plant deformation

Plant deformation is caused by pests that often live within plant tissues and their feeding damage brings about tissue deformations such as leaf galls, leaf mines, and leaf blistering. This damage can cause plant stunting and undesirable plant growth habits.

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
Blister & rust mite (Trombidiformes: Eriophyidae) includes: Cyclamen mite Fuchsia gall mite Lime nail gall mite Linden gall mite Maple bladder gall mite Pearleaf blister mite Peach silver mite Pine mite	Scout home landscape plants for unusual growth habits such as galls, leaf blisters, big buds, twisting needles, or curling leaves. Also scout for leaf or needle discoloration, (silvering, chlorosis). These mites can also cause fruit russeting. Often a 10- to 20x hand lens is needed to see these mite pests. In general, the damage caused by these pests is cosmetic and not detrimental to the overall health of the plant. When annual damage threatens plant health or growth form, this product targets the mites when they are active and before they are established in plant tissues; timing is key.	carbaryl horticultural oils [O] insecticidal soap [O] kaolin clay [O] pyrethroids [P] sulfur [O] spinosad [O]	abamectin chlorfenapyr diazinon diflubenzuron fenbutatin-oxide fypyroximate lime sulfur/ calcium polysulfide [O] pyridaben spiromesifen spirotetramat
Gall Aphid (Hemiptera: Aphididae) includes: Lettuce root aphid Manzanita leaf gall aphid Poplar petiole gall aphid	Scout landscape plants for the formation of galls on the leaves, needles or stems. Most products are contact and thorough coverage is essential. Pest species identification is important as these products must be applied before the pest gets into plant tissues.	none	carbaryl chlorpyrifos

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
(Hemiptera: Adelgidae) includes: Cooley spruce gall adelgid			
Gall Wasp (Hymenoptera: Cynipidae) includes: Bassettia gall wasp California jumping gall wasp Mossy rose gall wasp Oregon oak gall wasp Spiny rose gall wasp	Scout landscape plants for the presence of galls. Make sure these abnormal plant growths have active wasp larvae in them. Most products are contact and thorough coverage is essential. These products typically target the adult wasp before eggs are laid in leaf tissues. Some products are systemic and are better suited for tall trees and shrubs. Damage is primarily cosmetic. Damage can lead to premature defoliation, but healthy plants can recover unless this becomes an annual infestation.	carbaryl emamectin benzoate pyrethroids [P]	No additional products
Leafminer (Diptera numerous families) includes: Boxwood leafminer California gallfly Douglas-fir needle midge Honeylocust pod gall midge Poplar twiggall fly Rose midge Rose stem miner Willow beaked-gall midge	Species identification is key as leafminers represent different orders of insect with different pesticide susceptibilities. Labels may vary based on species. Scout landscape plants for the presence of galls, leaf mines, and rolled leaves. Make sure these abnormal plant growths have active maggots in them. Most products are contact and thorough coverage is essential. These products typically target the adult fly before eggs are laid in leaf tissues. Some products are systemic and are better suited for tall trees and shrubs. Damage is primarily cosmetic. Damage can lead to premature defoliation, but healthy plants can recover unless this becomes an annual infestation.	carbaryl clothianidin [S] imidacloprid [S] pyrethroids [P] malathion	abamectin cyantraniliprole
Leafminer (Lepidoptera: numerous families) includes: Aspen blotchminer Azalea leafminer Ceanothus leafminer Cypress tip moth Holly leafminer Lilac leafminer Madrona shield bearer Spotted tentiform	Species identification is key as leafminers represent different orders of insect with different pesticide susceptibilities. Labels may vary based on species. Scout for leaf- or needle-mining activity early in the season as leaves unfurl. Pheromone traps are available for some moth species. Most products are contact and thorough coverage is essential. These products typically target the adult pest before eggs are laid in leaf tissues.	acephate acetamiprid [S] azadirectin [O] carbaryl clothianidin [S] dinotefuran [S] emamectin benzoate fluvinate imidacloprid [S] insecticidal soap [O]	abamectin chlorantraniliprole chlorpyrifos cyantraniliprole diazinon diflubenzuron dimethoate fenpropathrin flupyradifurone methoxyfenozide

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
leafminer Spruce needleminer	Some products are systemic and are better suited for tall trees and shrubs. Damage is primarily cosmetic. Damage can lead to premature defoliation, but healthy plants can recover unless this becomes an annual infestation.	malathion pyrethrins [O] pyrethroids [P] spinosad [O] thiamethoxam [S]	novaluron pyriproxyfen
Leafroller (Lepidoptera: Tortricidae) includes: Carnation tortrix European leafroller Fruittree leafroller Holly bud moth Oblique-banded leafroller Orange tortrix Pine shoot moth Three-lined leafroller	Scout for and examine rolled leaves near branch tips for caterpillars. Pheromone traps are available for many of these moth species. Most products are contact and thorough coverage is essential.	acephate azadirectin [O] *Bacillus thuringiensis kurstaki* [O] carbaryl clothianidin [S] emamectin benzoate esfenvalerate horticultural oils [O] kaolin clay [O] malathion pyrethrins [O] pyrethroids [P] spinosad [O]	abamectin acetamiprid [S] *Bacillus thuringiensis aizawai* *Beauveria bassiana* [O] chlorpyrifos cyantraniliprole diazinon imidacloprid [S] methoxyfenozide novaluron phosmet spinetoram thiamethoxam [S]

O = Some formulations may be OMRI-listed for organic use.

P = The synthetic pyrethroids are broad-spectrum insecticides that include products with the active ingredients including bifenthrin, cyhalothrin, cyfluthrin, cypermethrin, deltamethrin and permethrin.

S = Systemic products that circulate within the plant's vascular system.

Table 4. Landscape plant damage by stem and trunk borers

This damage is caused by pests that bore into and feed on the plant stem, trunk, scaffold branches of perennial plants. Damage can girdle plant causing death to tissue above the damage and/or weaken the structural integrity of the plant leading to lodging, breaking and limb drop.

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
Bark Beetle (Coleoptera: Scolytidae) includes: Elm bark beetle European elm bark beetle European shothole borer Mountain pine beetle Shothole borer	Scout any weakened trees/shrubs for signs of infestation. Examine branches, twigs and trunks in late spring for small holes made by adult beetles. Examine inner bark of unhealthy trees or shrubs for larval galleries. Pesticides are generally not recommended because trees and shrubs are already in decline. These products intercept bark beetles before they bore into the host.	azadirachtin [O] clothianidin [S] imidacloprid [S] pyrethroids [P] thiamethoxam [S]	carbaryl chlorpyrifos fipronil pyrethrins [O]

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
	Insect pheromones are available to monitor some bark beetle species. Some beetle species transmit plant diseases.		
Wood or Trunk Borer (Coleoptera: Buprestidae) includes: Flatheaded cedar borer Locust borer (Coleoptera: Cerambycidae) includes: Bronze birch borer Mountain pine beetle	Scout any weakened trees/shrubs for signs of infestation. Examine any dead branches, twigs and trunks for beetle larvae galleries and adult exit holes. Pesticides are generally not recommended because trees and shrubs are already in decline. However, some products are labeled for specific borers. These products intercept adult beetles as they exit the host to visit another host plant.	acephate clothianidin [S] imidacloprid [S] pyrethroids [P]	chlorpyrifos
Stem & Twig Borer (Diptera: Cecidomyiidae) includes: Raspberry cane maggot Rose midge (Lepidoptera: Sessidae) includes: Ash borer Douglas-fir pitch moth Peachtree borer Sequoia pitch moth Other Lepidoptera includes: Carpenterworm Cherry bark tortrix Coneworm Cypress tip moth Maple tip moth Peach twig borer Snapdragon plume moth	Immature stages bore into or feed within plant stems, trunks or twigs. Most of these products target adults or intercept the pest before they enter plant. Proper application timing is key to product efficacy. Insect pheromones are available to monitor some borer species. When feasible cut off infested twigs, branches and terminals. When feasible, physically remove or kill borers with a pointed instrument or remove infested soil, debris, and pitch.	esfenvalerate horticultural oils [O] imidacloprid [S] pyrethroids [P] pyrethrins [O]	acephate chlorpyrifos diazinon malathion phosmet

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P = The synthetic pyrethroids are broad-spectrum insecticides that include products with the active ingredients including bifenthrin, cyhalothrin, cyfluthrin, cypermethrin, deltamethrin and permethrin.

S = Systemic products that circulate within the plant's vascular system.

Table 5. Landscape plant damage by root feeders and root borers

Subterranean pests that feed on or bore into the roots and crowns of plants can damage, deform or weaken plants reducing the plants ability to stand upright or to absorb the necessary water and soil nutrients to feed the aboveground portion of the plant.

Target pest examples	Monitoring & scouting strategies	Home landscape chemical products	Restricted-use chemical products
Beetle (Coleoptera: Cuculionidae) includes: Black vine weevil Clay-colored weevil Woods weevil (Coleoptera: Elateridae) includes: Wireworms, various (Coleoptera: Scarabaeidae) includes: White grubs, various	Beetle larvae with chewing mouthparts. Tend to be plant generalists and may impact only the newly planted ornamentals. Roots may appear damaged, missing tissues, bored through or hollowed out. Some beetles can gradually build up high populations in perennial crops where crop or soil rotations are not a management option. Effective products either intercept adult beetles as they oviposit eggs or specially formulated for soil application.	carbaryl clothianidin [S] imidacloprid [S] pyrethroids [P] spinosad [O]	acephate *Bacillus thuringiensis galleriae* *Beauveria bassiana* [O] beneficial nematodes [O] chlorantraniliprole chlorpyrifos cyantraniliprole dinotefuran [S] ethoprop phosmet thiamethoxam[S]
Root aphid (Hemiptera: Aphididae) includes: Beech blight aphid Leafcurl ash aphid Woolly elm aphid	Root feeders with piercing sucking mouthparts. Root deformation and plant stunting. A nuisance or cosmetic pest problem often when life stages migrate to the above ground portion of the plant. These products target only the above-ground population of these aphids. Most products are contact and thorough coverage is essential.	azadirachtin [O] pyrethrins [O] pyrethroids [P]	chlorpyrifos

O = Some formulations may be OMRI-listed for organic use.

P = The synthetic pyrethroids are broad-spectrum insecticides that include products with the active ingredients including bifenthrin, cyhalothrin, cyfluthrin, cypermethrin, deltamethrin and permethrin.

S = Systemic products that circulate within the plant's vascular system.

Hosts and Pests of Landscape Plants

Mike Bush and Sharon Collman

Latest revision—March 2024

Alder (*Alnus*)—Aphid

Includes
Alder aphid (*Pterocallis alni*)
Hop aphid (*Phorodon humuli*)
Woolly aphid (including leafcurl ash aphid, *Prociphilus fraxinifolii*)

Pest description and damage Mature alder aphids are about 0.05 inch in length and pale yellow with dark bands on light-colored antennae. Mature hop aphids are about 0.1 inch in length and pale yellow green with coalescing stripes that may form patches on their backs. Aphids may nearly cover the undersides of leaves. Feeding by the woolly aphids causes leaves to fold downward over the 0.1-inch blue-black aphids found covered by a woolly waxy material. Each species has a portion of adults that develop wings to disperse to alternate seasonal hosts, although the alder aphid does not alternate hosts. Deposit of honeydew and sooty mold beneath host plant are the primary pest concerns.

Biology and life history The hop aphid is one of the aphids common on plum. They overwinter in the egg stage on plum, alder and other trees. In spring, they migrate to hops. The winged form of the woolly aphid (small orange females and blue-black males) migrates from alder to maple where they mate and lay eggs on the bark of maple. Simultaneously, a small wingless form crawls down the alder trunk to overwinter under leaf litter at the base of the tree. They crawl back up in spring or fly back to the alder from maple.

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Alder (*Alnus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inch in length, covered with yellow or rusty- to black-colored silky hairs. Adults have about a 1-inch wingspan and are bright white with orange and black markings on the underside of their abdomen. Whitish moth scales cover and protect masses of 200 to 500 greenish eggs. Larvae can defoliate young trees.

For biology, life history, monitoring, and management

See:
Cottonwood (*Populus*)—Fall webworm

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Alder (*Alnus*)—Flea beetle

Alder flea beetle (*Macrohaltica alnus*)

Pest description and damage Adults are dark, shiny blue, and about 0.25 inch in length. Larvae are black and about 0.25 inch in length at maturity. Adults chew holes in leaves while the larvae feed in groups and skeletonize foliage of alder, poplar, willow dogwood and other hosts. They are capable of defoliating trees, but only rarely do. More often, they are found in smaller numbers and damage is scattered throughout the canopy.

Biology and life history The insects overwinter as adults and become active in spring. They may be seen in large aggregations in spring as they

emerge from hibernation. Adults feed on foliage before laying dull yellow eggs on leaves. Larvae usually are present in June and July and pupate in August. There is one generation per year.

Pest monitoring Watch for dark, metallic adults that emerge in the spring. If the number of adults is low, damage will be minimal. Later in the season, check abundance of the larvae. Control is not usually warranted in landscapes.

Management—biological control

This insect is generally under effective biological control since it is not commonly found in abundance. The fungus *Sporotrichium globuliferum*, a tachinid fly, and predatory stink bugs are reported to be natural enemies. As willow and red osier dogwoods are planted in riparian zones, there is a potential for predator populations to build up in these settings.

Management—chemical control

See Table 2 in:

For more information

See "Flea beetle" in:
Common Landscape Pests

Alder (*Alnus*)—Sawfly

Birch sawfly (*Arge pectoralis*)
Green alder sawfly (*Monsoma pulveratum*)
Striped alder sawfly (*Hemichroa crocea*)
Woolly alder sawfly (*Eriocampa ovata*)

Pest description and damage The larvae of these sawflies are sporadic pests of alder in the PNW. The larvae of the green alder sawfly, a recent introduction to the PNW, are about 0.8 inch in length and have a light green head with dark eyespots and a light bluish-green body with faint darker dorsal and side lines that help them blend with the leaf veins on the undersides of the leaves. Only one or two larvae will hatch one to two weeks after egg laying on a leaf and they lie straight rather than curled. Larvae develop over 5 to 6 instars and chew holes in leaves that are delimited by major veins. Striped alder sawfly lays eggs in slits in the leaf petiole or main vein. Larvae hatch and begin chewing tiny erratic channels in the leaves; these coalesce and expand out to the margin, leaving only the tougher veins. Larvae can be up to 0.3 inch in length and have a black head; the body has a dorsal green stripe and light sides with broken black lines along the sides. They line up along the edge of the leaf damage with their hind end curled up and out of the way. Mature larvae of the woolly alder sawfly are about 0.3 inch in length and found scattered in small groups on the undersides of newest leaves at branch tips. White wax covers the larvae; they rest in a U-shape and chew holes from the undersides of leaves. The larvae of birch sawfly are about 0.75 inch in length and feed on alder. Larvae are a pale, green with abundant black spots along the dorsum and two broken lateral stripes. Each larva has an orange head with yellow or orange overtones in the posterior end. The larvae of all these sawflies are capable of defoliating trees, but more often damage is limited to large numbers of holes scattered throughout the canopy.

Biology and life history Larvae overwinter as prepupae or in cocoons in the soil until spring. However, some can remain in the soil through the summer and do not emerge until the next spring. Sawflies that emerge in spring mate and lay eggs in or on leaves. Striped alder sawflies lay eggs in slits in the petiole or main veins in spring when leaves are fully expanded and may have several generations in a year. Research is ongoing to define the number of generations in Washington.

Pest monitoring Yellow sticky traps can be hung in alders in spring just as leaves are starting to unfurl. This removes the adults and limits the number of eggs, but also helps determine the level of potential infestation. Egg slits are visible in the petiole and main veins if the plant is small. Look into the canopy and watch for a leaf with squiggly channels in the leaves or for early holes in the leaves indicating larvae are present. On native plants in woodlots damage may be more tolerable than in a landscape setting. Damage rarely kills plants.

Management—cultural control

Removing larvae on small plants early in the season will reduce subsequent generations. For reasons unknown, sawflies can delay adult emergence for a year or more. They may be responding to environmental cues such as soil temperature, soil moisture or other factors.

Management—biological control

Little is known about biological control of sawfly larvae. Potential natural enemies include yellowjackets later in the season, and predatory bugs feed on larvae. Parasitoids may also regulate the frequency of heavy infestations.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Sawfly" in:
Common Landscape Pests

Furniss, R.L. and V.M. Carolin. 1980. Western Forest Insects. USDA Forest Service, Misc. Pub 1339.

Green alder sawfly (http://www.fs.usda.gov/detail/r6/forest-grasslandhealth/invasivespecies/?cid=stelprdb5303925)

Kruse, J.J., K. Zogas, J. Hard, and N. Lisuzzo. 2010. Pest Alert: New Pest in Alaska and Washington, The Green Alder Sawfly - *Monsoma pulveratum* (Retzius). USDA – USFS Alaska Region (http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5303926.pdf)

Alder (*Alnus*)—Tent caterpillar

Forest tent caterpillar (*Malacosoma disstria*)
Western tent caterpillar (*Malacosoma californica*)

Pest description and damage The western tent caterpillar attacks a wide variety of plants including alder, ash, birch, cottonwood, and willow as well as fruit trees and roses. The over 1-inch-long adult moths are attracted to lights at night. Mature western tent caterpillars can reach a length of about 2.0 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.625 inch in length, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

Biology and life history Tent caterpillars overwinter as egg masses on twigs (or buildings). The eggs hatch as buds break in April or May. Initially, caterpillars spin web-like tents about the tree crotches. These tents enlarge as the season progresses. The young larvae feed in groups for five to six weeks, growing larger and molting (shedding skins) four times. As they mature, they split into smaller groups and move to new feeding sites in the tree returning to the tent most evenings. In mid-June, the mature larvae congregate in large clusters on dense mats of webbing on the tree trunk and then begin to migrate in search of sheltered sites where they can spin their cocoons and pupate. Adults emerge seven to ten days later and fly in large numbers around lights at night. They mate and females lay the overwintering egg masses. There is one generation per year.

Pest monitoring Watch for egg hatch and the glint of the first white webbing of the tents early in the spring. A few tents do not threaten the health of the tree. The earlier the intervention, the more environmentally friendly options can be employed.

Management—cultural control

Trees that have been defoliated need additional, but not excessive, irrigation during dry summers to help them refoliate. Healthy trees will withstand defoliation better than closely spaced, drought-stressed trees. Remove egg masses from twigs or other sites. Cut out infested twigs and discard.

Management—biological control

Heavy infestations of tent caterpillars occur from time to time as the populations of the caterpillars and their predators rise and fall. Tent caterpillars have many natural enemies. Some birds eat the caterpillars, and small mammals and birds will consume the pupa inside the cocoons. A tachinid fly parasitizes the caterpillars by laying a white egg on the caterpillar; the hatching fly larva then burrows into and feeds within the caterpillar. A *Trichogramma* wasp will also parasitize eggs. When pruning out tent caterpillar egg masses, discard the masses in a protected area away from a host plant so these parasitoids can emerge naturally.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Johnson, W.T. and H.H Lyon. 1991. *Insects That Feed on Trees and Shrubs*. 2nd ed.

Andromeda (*Pieris japonica*)—Azalea bark scale

Eriococcus azaleae

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath protective wax scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Immature azalea bark scales resemble mealybugs in appearance. Mature female scales are about 0.13 inch in length and appear as tiny white cottony sacs, located on twigs, stems and branch axils of host plants. The eggs, crawlers and females beneath these whitish scales are reddish. Hosts include andromeda, azalea, rhododendron, hawthorn, poplar, willow, and most recently blueberries.

For biology, life history, monitoring and management

See:
Azalea (Rhododendron)—Azalea bark scale
See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Andromeda (*Pieris japonica*)—Lace bug

Azalea lace bug (*Stephanitis pyrioides*)
Rhododendron lace bug (*Stephanitis rhododendri*)

Pest description and damage These insects use piercing–sucking mouthparts to feed on individual plant cells on the lower leaf surface, so the upper leaf surface appears stippled. These stippled areas eventually turn yellow. The undersides of leaves are peppered with varnish-like "tar" spots. Infestations are more severe on plants in the sun. Damage is apparent from early to mid-July. Repeated infestations of rhododendron lace bugs may result in yellowed, sickly plants. Adult insects are whitish-tan and approximately 0.13 inch in length with lacy-looking wings. Nymphs grow to about 0.13 inch and are spiny.

For biology, life history, monitoring and management

See:

Azalea (*Rhododendron*)—Azalea and rhododendron lace bug

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Andromeda (*Pieris japonica*)—Root weevil

Numerous species

Pest description and damage Species identification is important as root weevil species differ in their susceptibility to pesticides and seasonal appearance of life stages. Adult weevils are 0.2 to 0.25 inch in length, dark colored, nocturnal beetles with a snout (rostrum) and elbowed antennae. They cannot fly, so distribution is generally through movement of infested plants, soil, or debris. The larvae are C-shaped, legless, and white or slightly reddish with tan heads, up to 0.5 inch in size. The larvae of all species are similar in appearance and feed on root hairs, larger roots and on the root crown. Look for ragged notches on the edges of leaves, or flower petals. Check the base of unthrifty shrubs for evidence of root or crown girdling by the larvae.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 5 in:

Chemical Control of Landscape Pests

Apricot, flowering (*Prunus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are covered with yellow to rusty- to black-colored silky hairs. Adults have a 1-inch wingspan and are bright white with orange and black markings on the underside of the abdomen. Whitish moth scales cover and protect masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Fall webworm

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Apricot, flowering (*Prunus*)—Peachtree borer

Synanthedon exitiosa

Pest description and damage Peach tree borer is native to North America and common in the Pacific Northwest. The adult is a metallic blue-black, clearwing moth. The male moth with a 1-inch wingspan may have bands of light-yellow scales on the abdomen and resemble a wasp. The female has a wingspan of 1.25 inches and an orange band around the abdomen. Full-grown larvae are 1.0 inch in length and whitish with a brown head. The larvae burrow into the bark of the crown and feed on the cambium. Feeding and tunnels are restricted to an area a few inches above and below the

soil line. Peachtree borer feeding damage can completely girdle and kill young trees. While older trees are rarely girdled, the damage reduces vigor and makes them vulnerable to other pests and diseases. Infested trees "bleed" a reddish amber frass and gum mixture during the growing season.

For biology, life history, monitoring and management

See:

Peach, flowering (*Prunus*)—Peachtree borer

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Apricot, flowering (*Prunus*)—Peach twig borer

Anarsia lineatella

Pest description and damage Peach twig borer is a European insect first found in California in the 1880s. It is a major pest of apricots, peaches, plums, and prunes. There are no native hosts outside the orchard. The adult is a steel-gray moth with white and dark scales, about 0.33 to 0.5 inch in length. The mature larva is approximately 0.5 inch in length, with a dark brown head and distinctive, alternating light and dark bands on the body. The pupa is smooth and brown. The larva of the borer causes injury to both fruit and twigs. Feeding on the buds and twigs occurs early in the season; later the larva bores into the shoots, causing a characteristic "flagging" or wilting of the new growth. Later generations of larvae feed on shoots or fruit causing blemishes.

For biology, life history, monitoring and management

See:

Peach, flowering (*Prunus*)—Peach twig borer

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Apricot, flowering (Prunus)—Spider mite

Includes twospotted spider mite (*Tetranychus urticae*) and others

Pest description and damage Several species of spider mites can cause damage to apricot. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Twospotted spider mites are oval and yellowish-brown or greenish with distinctive black spots on the body. Plants may be covered with fine silk webbing at branch axils or small branches may be engulfed in webbing under very heavy infestations. Mites damage leaves by sucking the contents of epidermal plant cells causing leaf stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of tree vigor and fruit yield.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Arborvitae (*Thuja*)—Cypress tip moth

Includes *Argyresthia cupressella* and others

Pest description and damage There are nine different *Argyresthia* species that attack different conifers (pine, hemlock, etc.) in the Pacific Northwest. The cypress tip moth (or cypress tip miner) is common enough to merit attention in many books. The moth is a mottled silver-tan and approximately 0.3-inch wingspan. The mature larvae are green, about 0.13 inch in length. The larvae mine in the growing points of the 1- and 2-year-old shoot tips. The cocoon is white and visible as a papery structure in the axils of leaf scales. Damage typically is limited to the tips of twigs. The exit holes are dark and may resemble symptoms of leaf blight, a fungal disease. Affected foliage does not discolor until late winter. After this, the brown dead twigs break off readily. Cultivars of *Juniperus chinensis, J. virginiana,* and *J. sabina* also are affected. The entire plant can appear brown in a severe infestation, and repeated infestations cause dieback. Failure to gain control may require taxonomic identification to ensure the *Argyresthia* species.

For biology, life history, monitoring and management

See:

Juniper (*Juniperus*)—Cypress tip moth

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Arborvitae (*Thuja*)—Borer

Western cedar bark beetle (*Phloeosinus punctatus*)
Flatheaded cedar borer (*Chrysobothris nixa*)
Shothole borer (*Scolytus rugulosus*)

Pest description and damage Beetle borers are pests of many different trees and shrubs. The 0.5-inch cedar borer adults are either brown to metallic gray or black with a red or orange sheen, depending on species. The larvae are whitish to pale yellow grubs about 0.5 inch in length when fully developed and bore within the wood and bark of host plants. Just behind the larval head is a broad, flat enlargement giving the larvae a flat-headed appearance. Bark beetle (including shothole borer) adults are brown beetles less than 0.08 inch in length. Bark beetle larvae feed just beneath the bark on the trunk leaving characteristic engravings. The damage may girdle the trunks and branches of trees leading to death of tissues distal to the damage. Holes made by feeding beetles may be associated with weeping sap on the trunk. Young, recently planted trees are most susceptible as are trees that are stressed due to drought or other plant stresses.

Pest monitoring Watch for watersoaked areas, depressions in the bark or cracks through which frass may be seen.

Management—biological control

Birds peck the larvae from under the bark. Some wasp parasites attack the borer. Carpenter ants eat both larvae and pupae from the wood but may in turn colonize and expand borer tunnels into galleries for their nest.

Management—cultural control

As the adult borer is attracted to weakened trees, the best control is to keep trees healthy. Larvae cannot thrive in trees that are vigorous and full of sap. Avoid wounding plants, and follow good pruning, watering, and fertilization practices. To prevent sunburn, paint the trunk with white latex paint. Keep weeds, grass, and trash from the base of the trees to make it easier to detect and remove borers.

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Arborvitae (*Thuja*)—Root weevil

Includes
Black vine weevil (*Otiorhynchus sulcatus*)
Clay-colored weevil (*Otiorhynchus singularis*)
Woods weevil (*Nemocestes incomptus*)

Pest description and damage Identification is important: the various root weevil species differ in susceptibility to pesticides and have different life cycles. Adult weevils are 0.2 to 0.25 inch in length, dark, nocturnal beetles with a snout (rostrum) and elbowed antennae. The C-shaped, legless larvae are white or slightly reddish with tan heads, up to 0.5 inch in size. Check base of shrubs for girdling by larvae resulting in unthrifty appearance or death of the plant.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 5 in:

Chemical Control of Landscape Pests

Arborvitae (*Thuja*)—Scale insect

Includes
Black pineleaf scale (*Dynaspidiotus (Nuculaspis) californica*)
Juniper scale (*Carulaspis juniperi*)
Pine needle scale (*Chionaspis pinifoliae*)

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The needle scale insects are about 0.125 inch in diameter, elongate, under white scale. Each scale has a cast larval skin at the narrow end. Males are smaller and more elongate. Red eggs are laid beneath the female scale. The newly hatched crawlers are yellow and flat. The more mature nymphs and adults feed on the needles. Heavily infested trees may appear crusty white or "flocked." Infested needles turn yellow, then brown. Twigs and branches may be killed. Repeated infestations eventually may kill plants. Pine needle scales are often found with the black pineleaf scales, which are convex scales, about 0.06 inch in length, black with gray margins and a central yellow area. Pine needle scales are most serious on

ornamental pines that are under stress or along dusty roads. This insect may infest arborvitae, cedar, hemlock, spruce, and Douglas-fir. The female juniper scales are about 0.06 inch in diameter, shaped like a small round volcano with a yellow top (cast off crawler "skin"), while the males are elongate with the cast skin at the narrow end. Crawlers are bright yellow, but fade to tan as they begin to form the scale cover.

Biology and life history The pine needle scale overwinters as red eggs under cover of the female scale. Eggs hatch in spring and reddish crawlers move along needles and molt, becoming yellow with a dark central spot. A second generation occurs in mid-summer (July). Black pineleaf scale eggs are laid in June and hatch into crawlers in July and spend winter feeding on foliage. There is one generation per year in Oregon. Juniper scale overwinters as eggs beneath the female scale. Eggs hatch in spring and the pale-yellow crawlers move to the last season's needles. Once females settle, they will remain in that spot.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

For more information

Anon. Juniper scale in Pests of Trees and Shrubs. IPM of Midwest Landscapes, p. 159. University of Minnesota. p.159 (http://cues.cfans.umn.edu/old/Web/159JuniperScale.pdf)

Arborvitae (*Thuja*)—Spider mite

Includes spruce spider mite (*Oligonychus ununguis*)

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen, and coniferous ornamentals. Mites are all 0.02 inch or smaller. Nymphs are yellowish green and as they mature, they develop a grayish-black abdomen with tan-colored legs and head area. Spider mites damage leaf scales and fruit indirectly by feeding on leaves causing leaf stippling and bronzing that later turns brown. The reduction in photosynthesis causes loss of vigor.

For biology, life history, monitoring and management

See "Spider Mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Ash (*Fraxinus*)—Aphid

Includes leafcurl ash aphid (*Prociphilus fraxinifolii*)

Pest description and damage Leafcurl ash aphids cause significant curling and twisting of ash leaves that provide protection for the white, waxy, 0.1-inch aphids inside. The consensus is that damage substantially disfigures leaves but does no lasting damage as the leaves continue to photosynthesize sugars for the plant.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Ash (*Fraxinus*)—Ash borer

Ash borer (*Podosesia syringae*)

Pest description and damage The ash borer, also known as the lilac borer, is a larva of a clearwing moth that attacks ash as well as lilac, privet, and other members of the olive family. The adult moth ranges from 1 to 1.25 inches in length and resembles a paper wasp, with orange and yellowish markings on a black body. As the larvae bore into the woody branch, a thin wet stain is followed by a mix of frass and sap. Areas around the entry site may become sunken, and frass and sawdust may accumulate around the base of plants. Eventually, plants show branch dieback, weaken, or die.

For biology and life history Adult clearwing moths emerge in spring from a round hole at the top of their gallery. They mate and lay eggs on the bark at the base of plants and the young larvae tunnel under the bark.

Pest monitoring Deploy pheromone traps in spring to determine when the moths emerge. Watch for wet sunken areas in the bark at the base of the tree/bush. Often the pupal case will still protrude from the exit hole indicating adult emergence. Spotting old damage will provide some indication of how heavy the infestation is and the extent of moth management next season.

Management—cultural control

Pheromone traps are available for this pest and will attract males to the trap preventing males from reaching females. Properly prune out infested branches during fall or winter when moths are not active as the moths often seek out injured areas on the bark. Do not compost as moths may still emerge. Insert a knife or wire into the borer hole to kill larvae and pupae. Prune properly for a faster sealing wound.

Management—biological control

Entomopathogenic nematodes are available. They are sprayed at the base of trees near entry wounds so the nematodes can find their way into the borer galleries.

Management—chemical control

See Table 4:

Chemical Control of Landscape Pests

For more information

See "Wood Borers" in:

Common Landscape Pests

Missouri Botanical Garden. Lilac Borer and Ash borer (http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/help-for-the-home-gardener/advice-tips-resources/pests-and-problems/insects/caterpillars/lilac-borer-and-ash-borer.aspx)

Ash (*Fraxinus*)—Carpenterworm

Prionoxystus robiniae

Pest description and damage The carpenterworm larvae bore in the trunk and main branches. Discolored or bleeding limbs, branch dieback, and lumpy or gnarled trunks may be indications of carpenterworm infestation. Look for sawdust-like material (frass) and wood chips mixed with loose webbing on or around the surface of infested trees. Trees or branches with severe carpenterworm infestations are susceptible to wind breakage and may need to be removed if they pose a safety hazard. The adult moths are 1.75 to 3.0 inches in length and mottled gray and black in color.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Carpenterworm

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Ash (*Fraxinus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inch in length, covered with yellow to rusty- to black-colored silky hairs. Adults have a 1-inch wingspan and are bright white with orange and black markings on the underside of their abdomens. Whitish moth scales cover and protect masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Ash (*Fraxinus*)—Lecanium scale

Includes *Parthenolecanium corni*

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Lecanium scales are most noticeable as the female scales expand in size in the spring. As females swell in the spring, they produce large egg masses under their scales and release considerable honeydew that coats nearby foliage. The female lecanium scales are about 0.13 inch in diameter and vary from red to dark brown in color. They are oval and resemble small "helmets," "turtles," or bumps on branches and stems. Male scales are smaller, flat, and oblong. Crawlers are pale yellow and overwinter on stems.

Biology and life history Lecanium scales overwinter as immatures on twigs and branches. They resume feeding in the spring and begin to swell; the males, when mature, escape from beneath the scale, and fly to find females. The fertilized female swells to a hemispherical shape and eggs are laid underneath the scale in May–June. The females are initially soft and exude honeydew, then harden. The eggs remain under the scale until hatching in early summer. Newly hatched yellowish-brown crawlers congregate on small branches, twigs, and the undersides of leaves. When infestations are heavy, crawlers are found on the upper surface of leaves, and on the fruit. Young scales are dispersed by wind, rain, irrigation, or by people and machinery. After four to six weeks on the leaves, the young return to the stems and twigs to feed and overwinter. There is one generation per year.

Pest monitoring Inspect twigs during the dormant season for flat pale-yellow scale crawlers. Pay attention to weak plants. In late spring, examine beneath any hemispherical females to determine if eggs are still present (tiny beads roll out from beneath the scale) or have hatched (white fluff beneath the scale). The new crawlers are detected, using black tape with sticky side out on twigs near old scales, in May. Crawlers are best observed through a 10X magnifying glass.

Management—cultural control

Remove or squash swelling scales in the spring when they are just starting to mature or prune out heavily infested branches.

Management—biological control

Several predatory mites and parasitoid wasps feed on these scale insects. Check beneath scales for predator mites or wasp grubs to determine mortality. Holes in the top surface of scales indicate that parasitoids have already emerged.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

See "Scale insect" in:
Common Landscape Pests

Ash (*Fraxinus*)—Lilac leafminer

Gracillaria syringella

Pest description and damage The adult insect is a mottled golden yellow moth about 0.5 inch in length. The larvae that mine within the leaf tissues are small, pale yellow to green caterpillars, 0.125 to 0.25 inch long. The larvae mine leaves during the early part of their development. Later, the larvae leave the mine, roll and tie together leaf tips to feed on the tissues within the rolled leaf.

For biology, life history, monitoring and management

See "Leafminer" in:
Common Landscape Pests

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Ash (*Fraxinus*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature oystershell scale is approximately 0.13 inch in length, with a brownish, or gray scale that is usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs of many broad-leaved deciduous plants. They occur less frequently on the leaves and other plant parts like fruit and seed pods. Scale infestations often are initially limited to isolated colonies on single branches or twigs. Newly emerged crawlers look like minute, bright white pimples on the bark.

Biology and life history The oystershell scale overwinters as the egg stage beneath the scale and do not hatch until early summer. The new crawlers are white and only crawl about for a few hours before settling in place and beginning to build the shell. Initially, the scale cover is a loose lattice of white wax that remains vulnerable to any pesticide applications until late summer when it forms a more solid scale covering. Once the solid scale is

completely formed, they are less vulnerable to pesticides, but still vulnerable to predators and parasitoids.

Pest monitoring Use double stick tape to trap crawlers or inspect around infestations for the bright white crawlers in mid to late June. New scales have a fresh pinkish look to them, while old dead scales become gray. Since the waxy scales remain after insects have died, it is important to sample the patches of scales to determine if this is a live infestation, or if the scales were controlled by natural enemies.

Management—cultural control

For small infestations, scrape away the scales with fingernail or stiff brush. Hang a bird feeder in the tree to attract insectivorous birds to the area.

Management—biological control

Parasitoid wasps and predatory mites feed on life stages of the oystershell scale. There is a definite reduction in the number of eggs produced when predatory mites are present. Other predators include lady beetles and birds such as chickadees, nuthatches and brown creepers. Search for smooth round holes (parasitoid exit holes), ragged holes (beetle predation) in each scale, or white areas where the scales have been removed (bird predation) to determine the level of natural enemies and surviving scale abundance.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

See "Scale insect" in:
Common Landscape Pests

Aspen (*Populus tremuloides*)—Aspen leaf blotch miner

Phyllonorycter apparella

Pest description and damage Adults of this insect are tiny moths with about a 0.2-inch wingspan. Early instar larvae are flat and mine within leaves of the host. The larvae produce blotched mines, which may be more visible on one side of the leaf. Miners spin silk across the leaf surface, which dries and shrinks to create a ridge over the mine. The larvae feed initially on sap, and then feed on tissue inside the leaves during summer. There may be more than one generation per year.

Management—cultural control

Pick off infested leaves when practical on smaller plants. Aspen and cottonwood trees are very susceptible. Plant resistant tree varieties in areas where serious blotch miner infestations exist.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more information

See "Leafminer" in:
Common Landscape Pests

Aspen (*Populus tremuloides*)—Poplar twiggall fly

Euhexomyza schineri

Pest description and damage Adults are stout, shiny, dark flies about 0.16 inch in length. The developing gall fly is a greenish-yellow maggot that causes galls to form on the current season's twigs. Obscured by leaves, the original galls rarely are noticed until leaves fall in autumn. However, the galled tissues continue to grow and swell. Ultimately, galls become large knots on trunks and larger branches, giving the plants a gnarled, bonsai-like appearance. During subsequent years, the galled area is incorporated into the growing twigs and branches and ultimately may appear as large swollen bands on trunks and branches. Although these old injuries produce a permanent disfigurement, they do not seem to threaten tree health. Serious galling has been limited to aspen. However, small numbers of galls sometimes are seen on other *Populus* species. Galling is most common on younger trees that produce a lot of succulent new growth.

Biology and life history The poplar twiggall fly overwinters within the gall as a full-grown, yellow-green maggot. Pupation occurs within the gall in late winter or early spring. Most of the pupae then drop to the ground. As new leaf growth begins, the adult flies emerge from the pupae and become active. During the day, they rest and sun themselves on leaves. After mating, females move to developing twigs and insert eggs into the stems. The larvae hatch from these eggs and produce distinctive swelling in response to their feeding. Areas below buds appear to be particularly favored sites for galls. As the stems continue to grow, the area where eggs are laid becomes increasingly swollen. At first, the swelling involves an indistinct enlargement. However, within two months, the full-sized gall is usually present. The developing gall fly maggot grows slowly within the gall all summer. It is difficult to find until late summer and fall, when it grows rapidly, filling a small cavity within the swollen area of the twig. Individual galls typically contain two to three larvae. There is one generation per year.

Management—cultural control

Removal of galls has limited potential for control. Pruning often requires substantial branch destruction and creates wounds that can allow pathogens

to enter. Furthermore, this practice can be counterproductive if done after flies emerge in late winter or early spring. Late pruning may remove only those galls that contain the natural enemies (including parasitic wasps) of the poplar twiggall fly. Because problems with poplar twiggall fly are most severe in succulent aspen, do not over water or fertilize plantings. If the vigor of aspen growth can be moderated, then gall production can be slowed.

Management—biological control

Parasitic wasps may give some control. In addition, birds feed on the larvae.

Management—chemical control

No effective chemical controls have been developed.

For more information

See "Gallmakers" in:

Common Landscape Pests

Cranshaw, W.S. 2011. Poplar twiggall fly. Colorado State Univ. No. 5.579 (https://extension.colostate.edu/docs/pubs/insect/05579.pdf)

Aspen (*Populus tremuloides*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature oystershell scale is approximately 0.125 inch in length, hard-shelled, pinkish (alive) or gray (dead) in color, and usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs. This scale occurs less frequently on the leaves and other plant parts. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Newly emerged crawlers look like bright white pimples on the bark.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Oystershell scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Aucuba (*Aucuba japonica*)—Aphid

Foxglove aphid (*Aulacorthum solani*) and others

Pest description and damage The foxglove aphid has been reported on aucuba. This aphid is about 0.1 inch in length and pale green with dark green patches at the base of each cornicle. The antennae are banded black and pale green. Clusters of green aphids feed on the undersides of leaves making them difficult to detect. Leaves may pucker in response to aphid feeding and sooty mold develops on underlying leaves.

Biology and life history This is an aphid that thrives in the cool of winter. As the weather warms in spring, winged forms are produced and the aphid flies to any of its many alternate hosts.

Pest monitoring Watch for the first signs of honeydew as you pass by plants. Yellow sticky traps may catch incoming aphids, and water sensitive paper are used for monitoring honeydew.

Management—chemical control

See Table 1:

Chemical Control of Landscape Pests

For more information

See "Aphid" in:

Common Landscape Pests

Azalea (*Rhododendron*)—Azalea bark scale

Eriococcus azaleae

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The immature azalea bark scale superficially resembles a mealybug in appearance. Mature female scales are about 0.13 inch in length and appear like white cottony sacs, often located on twigs and stems of azalea, especially in branch axils. Eggs, crawlers, and adults under the whitish

scales are red. Hosts include andromeda, azalea, rhododendron, hawthorn, poplar, willow, and most recently, blueberry in the Pacific Northwest.

Biology and life history The azalea bark scale overwinters as an adult and lays eggs in the spring. The young scales (called "crawlers") are the mobile form of this insect; they migrate through the foliage to feed. As they feed and mature, they form a protective shell over their bodies. There is usually one, or possibly two, generations per year.

Pest monitoring Inspect twigs and tissues during the dormant season for scale insects. Pay attention to sickly plants and those with low vigor. The newly emerged crawler is the stage most susceptible to chemical control. Monitor for crawlers by wrapping a piece of sticky tape around an infested branch with the sticky side out. The red crawlers are very small and best observed with a 10X magnifying glass.

Management—biological control

Several species of beetles and parasitic wasps help control scale populations. Check beneath the waxy scales to determine if there is a live infestation. Avoid use of broad-spectrum insecticides, which can kill these predators.

Management—cultural control

Scrape scales off plants by hand with fingernail or toothbrush. Prune off major infestations. Apply double-stick tape near infestations of adult scales to catch the crawler stage. As with aphids, avoid excessive nitrogen fertilizer, as this favors population increase.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

See "Scale insect" in:
Common Landscape Pests

Rosetta, R. 2006. Azalea bark scale (https://agsci.oregonstate.edu/nurspest/insects/azalea-bark-scale)

Azalea (*Rhododendron*)—Lace bug

Azalea lace bug (*Stephanitis pyrioides*)
Rhododendron lace bug (*Stephanitis rhododendri*)

Pest description and damage Lace bugs are tiny true bugs that cause significant feeding damage to broadleaf evergreens including andromeda, laurel, pyracantha, and rhododendron. Adult insects are whitish-tan and approximately 0.13 inch in length with lacy-looking wings. Nymphs grow to about 0.13 inch and are spiny. The insects use piercing–sucking mouthparts to feed on individual cells, so the upper leaf surface is yellow and stippled. The underside of leaves is covered with dark varnish-like "tar" spots. Leafhopper damage is similar but lacks tar spots. Infestations are more severe on plants in the sun. Damage is usually apparent from early to mid-July. While almost never fatal, repeated infestations of rhododendron lace bugs may result in yellowed, sickly plants. Identification is based on the dark markings on the thorax and wings.

Biology and life history Eggs overwinter in crusty brown patches along the midribs of leaves. These hatch into spiny nymphs which begin to feed on the undersides of leaves. The lacey winged adults may be present through late summer and fall. There are several species attacking ornamentals, and these may have different life cycles. The pattern on the wing can be diagnostic, as well as spines on the larvae. There is probably one generation a year in Oregon.

Pest monitoring In winter, look for crusty brown patches of eggs along the midrib. This will provide some early warning regarding the numbers likely to hatch in the spring. Watch for the appearance of first instar nymphs, the most vulnerable stage if control is needed.

Management—cultural control

Maintain plant health by providing proper water and nutrition. Stressed plants are more susceptible to insect damage. Grow azaleas in shady areas to minimize damage. Remove leaves with brown patches of eggs along the midrib. Hosing plants with a strong stream of water directed at the underside of leaves will help to remove some adults and wingless nymphs. Resistant azalea cultivars include: 'Autumn Amethyst', 'Autumn Twist', 'Autumn Royalty', 'Autumn Sangria', 'Autumn Cheer', and 'Autumn Rouge'. In addition, some cultivars are moderately resistant: 'Autumn Embers', 'Autumn Bravo', 'Autumn Starlite', 'Autumn Ruby', and 'Autumn Princess'.

Management—biological

Release of lacewing larvae have proven successful in one experimental test. Select insecticides to preserve populations of beneficial predators that will help control lace bugs.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Azalea (*Rhododendron*)—Azalea leafminer

Caloptilia azaleella

Pest description and damage The adult insect is a golden yellow moth about 0.5 inch in length with antenna that run the length of the moth's body. The larvae are small, pale yellow to green caterpillars, 0.125 to 0.25 inch long. The larvae mine leaves during the early part of their development. During later stages of their development, they also roll the leaves and skeletonize them.

Biology and life history The insect overwinters as a pupa in rolled leaves, or possibly as a larva in a mined leaf. After the adult moth emerges, eggs are laid singly on the underside of leaves. The larvae emerge and mine into the leaf, causing the mined tissue to turn brown. They then emerge from the leaf and roll it over their bodies with silk for protection as they feed. Later, they select an undamaged leaf, roll it up, and pupate in it. The adult moth emerges about a week later. There may be two to three generations per year.

Pest monitoring Observe early spring growth for rolled leaves and feeding damage.

Management—biological control

Very low temperatures in winter significantly reduce overwintering populations. Spiders and parasitic/predatory insects greatly reduce populations throughout the year.

Management—cultural control

Hand-pick larvae if found. Removing rolled leaves in winter can reduce next year's population.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

For more information

See "Leafminer" in:

Common Landscape Pests

Baker, J.R. Azalea leafminer (https://content.ces.ncsu.edu/azalea-leafminer)

Azalea (*Rhododendron*)—Oblique-banded leafroller

Choristoneura rosaceana

Pest description and damage The oblique-banded leafroller larvae roll and tie leaves together for shelter and feeding. The newly hatched larvae first surface mine leaves, then roll and tie the leaves together. They are first detected by an abundance of feeding holes in leaves. The larvae are green caterpillars with a light brown to black head. Mature larvae range from 0.75 to 1.0 inch in length. When disturbed, they thrash about violently, wriggle backwards, and may drop from the leaf suspended by a silken thread. Their feeding on growing points on young plants can promote undesirable branching. The adult moth has a wingspan of between 0.75 and 1 inch,

For biology, life history, monitoring and management

See:

Cherry, flowering (*Prunus*)—Oblique-banded leafroller

See "Leafroller" in:

Common Landscape Pests

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Azalea (*Rhododendron*)—Root weevil

Numerous species in several genera, including *Nemocestes*, *Sciaphilus*, *Sciopithes*, *Strophosoma*, and *Trachyphloeus*

Pest description and damage Identification is important: species differ in susceptibility to pesticides. Adult weevils are dark colored, 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. They cannot fly so distribution is generally through movement of infested plants, soil, or debris. Also, the adults of most of the species are all females and capable of laying eggs after a period of feeding to mature their ovaries. They are slow moving and not confused with swifter predacious ground beetles. Larvae, found around roots, are C-shaped, legless, and white, or slightly reddish, with tan heads, up to 0.5 inch in size. All species are quite similar in appearance and habits of feeding on root hairs, then larger roots and finally the root crown. Adult weevils are night feeders that mostly remain in the soil or in debris at the base of the plant during the day. At night, they may climb up to feed on leaves. Look for ragged notches on the edges of leaves, or flower petals or dead tips of plants where weevils have girdled the twig (yew, juniper, rockrose, etc.).

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 5 in:
Chemical Control of Landscape Pests

Azalea (*Rhododendron*)—Azalea sawfly

Euura lipovskyi

Pest description and damage Azalea sawfly adults are small black fly-like insects. The larvae are green and closely match the leaf color of their host plants. They feed only on *Rhododendron mollis* and *R. occidentalis* azaleas. The larvae feed on leaves at the tips of twigs and branches. Generally, one or two larvae per leaf feed along the edge up to the midrib leaving only the midribs. Damage is restricted to the tips of branches but occasionally plants can be entirely defoliated.

Biology and life history Sawflies overwinter in cocoons in the soil and emerge just as the new leaves emerge. Adults swarm when the sun is shining on the host plants. Eggs are laid singly along the leaf edge and the small larvae begin to feed along the leaf edge. There is only one generation in a year.

Pest monitoring Larvae are so well matched to the color of the leaf edge that they are very difficult to see. Look for tiny dark specks of frass on leaf surfaces below feeding larvae, then look up to find the larvae. Start looking for flying sawflies or use yellow sticky traps to trap flying adults as the first leaves open; or watch for frass on leaves shortly after flowering.

Management—cultural control

Handpicking of insects is possible on small plants but more difficult on large species. The larvae are so cryptic that they are hard to see so continuously watch for fresh brown specks of frass. Use a beating sheet to dislodge larvae.

Management—biological control

Little is known of biological controls.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Sawfly" in:
Common Landscape Pests

Johnson, W.T. and H.H Lyon. (1991). *Insects That Feed on Trees and Shrubs*. 2nd ed., Cornell University Press.

Azalea (*Rhododendron*)—Spider mite

Tetranychus spp.

Pest description and damage Several species of spider mites can cause damage in deciduous or particularly evergreen azaleas. Appearance of these mites varies with the species, although all are 0.02 inches or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Spider mites are oval and yellowish-brown or green with distinctive black spots on the body. Mites damage leaves and fruit indirectly by feeding on leaves that causes stippling, bronzing, and sometimes leaf drop. The reduction in photosynthesis causes loss of vigor.

For biology, life history, monitoring and management

See "Spider mite" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Bamboo (*Bambusa* and others)—Aphid

Takecallis arundinariae

Pest description and damage The bamboo aphid is yellow with black markings. Aphids tend to be small (.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. They feed in colonies and are found on the most succulent plant tissues. Feeding damage to bamboo is usually minor, but can compromise the vigor of the plant, and may result in some leaf and shoot distortion if aphid populations are high. Aphids produce honeydew, a sweet, sticky secretion that collects on plant tissues and encourages growth of a black sooty mold.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

For more information

Hortsense Bamboo Aphid (http://hortsense.cahnrs.wsu.edu/Public/FactsheetWeb.aspx?ProblemId=321)

Bamboo (*Bambusa* and others)—Bamboo spider mite

Stigmaeopsis (*Schizotetranychus*) *longus*

Pest description and damage Bamboo mites have a flattened body that is a straw- to greenish-yellow color with small blackish green spots. First impression is that leaves are under attack by a leafminer or virus. The mite feeding on the plant cell contents leaves a distinct damage pattern of long rectangular yellow patches visible on both sides of the leaf. Preferred bamboo hosts for this mite include the genera *Sasa*, *Indocalamus*, *Phyllostachys*, and *Pleioblastus*.

Biology and life cycle These mites form colonies on the underside of the leaves and live under a densely woven web. Generally, the mites remain under the web to feed and lay eggs, but leave to defecate in black fecal piles slightly removed from the nest. Adults and nymphs sometimes are found outside the webbing, particularly as they begin to form new nests. Multiple males and females are found in the web nests, and often many webbed nests form alongside each other running down the underside of the bamboo leaves. There are many generations per year.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Barberry (*Berberis*)—Lecanium scale

Includes *Parthenolecanium corni*

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Lecanium scales are most noticeable as the female scales expand in size in the spring. As females swell in the spring, they produce large egg masses under their scales and release considerable honeydew that coats nearby foliage. The female lecanium scales are about 0.13 inch in diameter and vary from red to dark brown in color. They are oval and raised, resembling small "helmets," "turtles," or bumps on branches, and stems. Male scales are smaller, flat, and oblong. Crawlers are pale yellow, overwinter on stems.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Lecanium scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Beech (*Fagus*)—Aphid

Beech blight aphid (*Grylloprociphilus imbricator*)
Woolly beech aphid (*Phyllaphis fagi*)

Pest description and damage Several species of aphids can become problems on beech. Both species are woolly aphids. Beech blight aphids form masses of bluish-white woolly aphids on the undersides of stems, sometimes causing the death of twigs, small branches, and even young trees. The woolly beech aphid is about 0.1 inch in length, but waxy filaments may make it look longer. It is especially common on the undersides of purple leaf beech varieties. The aphid is greenish with prominent long waxy strands. Often, these aphids remain under control from natural enemies, but if pesticide practices have upset the balance, aphid populations may soar.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Beech (*Fagus*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature oystershell scale is approximately 0.125 inch in length under a brown, or gray scale, and usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs of many broad-leaved deciduous plants. They occur less frequently on the leaves and other plant parts. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Newly emerged crawlers look like bright white pimples on the bark. This scale can kill branches and even entire trees.

For biology, life history, monitoring and management

See:
Ash (*Fraxinus*)—Oystershell scale

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Bergenia (*Bergenia*)—Root weevil

Includes black vine weevil (*Otiorhynchus sulcatus*)

Description and damage Adults are hard-bodied weevils with a broad snout and elbowed antennae. The black vine weevil is black in color with tufts of yellow scales in rows along the top of the beetle. They are visible by flashlight at night straddling the leaf as they feed. Feeding results in ragged leaf edges. Because leaves are "evergreen," damage accumulates over time.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

See Table 5 in:
Chemical Control of Landscape Pests

Birch (*Betula*)—Aphid

Includes
Common birch aphid (*Calaphis betulaecolens*)
European birch aphid (*Euceraphis punctipennis*)

Pest description and damage The common birch aphid is a large (0.12 to 0.14 inch in length) lemon-green aphid, and the European birch aphid is a larger (0.12 to 0.2 inch long) pale green aphid with dark green to black bars on its back. They both feed on the undersides of leaves and produce copious amounts of honeydew. Sometimes birch begins to lose its leaves by late summer; excessive aphid feeding may compromise the vigor of the host. Aphid honeydew is a sweet, sticky secretion that collects on underlying plant tissues and encourages growth of a black sooty mold. In addition to cosmetics, honeydew may become a sticky nuisance when it falls on decks, cars, or other landscape surfaces.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—cultural control

Ensure that the plant receives enough water through the season. Plant birch away from driveways, patios, and decks to minimize the nuisance of honeydew.

Management—biological control

Check the tree trunk for ladybeetle adults, eggs, larvae, and pupae. Also, check for swollen tan or gray aphids stuck to the undersides of leaves as these are signs of aphid parasitoids.

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Birch (*Betula*)—Apple-and-thorn skeletonizer

Choreutis pariana

Pest description and damage Adult moths are reddish brown, with a wingspread less than 0.5 inch, and irregular light and dark bands on the wings. Mature larvae are 0.5 inch in length, yellowish to greenish, with black spots and a yellow-brown head. Pupae are yellow to brown with a white silken cocoon. The larvae skeletonize and roll leaves usually from the sides and tip. Damaged leaves are brown and papery and drop prematurely. Damage varies from inconsequential to serious, so monitoring is an important management tool.

For biology, life history, monitoring and management

See:

Crabapple (*Malus*)—Apple-and-thorn skeletonizer

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Birch (*Betula*)—Birch leafminer

Fenusa pumila

Pest description and damage The adults are a small (0.125 to 0.375 inch in length) black sawfly. Mature larvae are flattened and up to 0.5 inch long. The larvae feed between the leaf surfaces, leaving blotch-shaped or winding brown mines. Severe infestations over consecutive seasons may result in decline of trees. Vigorous gray, white, and paper birches are attacked most. In some years, infestations are heavy.

Biology and life history The adult sawfly lays eggs in new leaves. When fully developed, the larvae drop to the ground and pupate in the soil for two to three weeks before emerging as adults. There may be up to four generations per year, depending on the length of growing season.

Pest monitoring Check leaves once they are fully formed to assess the numbers starting in spring. Revisit trees to check on the population of subsequent generations.

Management—cultural control

Pinch leaves to kill larvae in minor infestations in small trees. Plant resistant species and cultivars that include *Betula costata, B. davurica, B. maximowicziana, B. utilis var. jacquemontii, B. nigra, B. schmidtii,* and the varieties ‘Crimson Frost’ and ‘Purple Rain.’

Management—biological control

Severe infestations but are soon brought under control by natural enemies. Monitor to determine if parasites or predators are active before initiating controls.

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Birch (*Betula*)—Bronze birch borer

Agrilus anxius

Pest description and damage Adult is an olive-brown beetle with a blunt head and a tapering body about 0.5 inch in length. Larvae of flatheaded borers grow to about 1 inch long and are creamy to white in color with a head wider than the body. The larvae bore into the branches or trunk after hatching and bore winding galleries along the cambial layer (between the wood and the bark). The galleries may heal, with swelling showing on the outside of the tree (lumpy bark), or they may girdle and kill distal branches or canopy. Leaves distal to the girdling may become yellow (chlorotic) and wilt. The adult beetles may feed on leaves but cause relatively little damage. Bronze birch borers attack trees weakened by age, environmental stresses, or previous insect attacks.

Biology and life history The insect overwinters as a larva in the tree. As the weather warms in spring, the larvae resume feeding. They pupate in the tree. In late spring the adult insect chews a D-shaped hole in the bark to emerge. They lay their eggs in bark cracks or under bark flaps. The larvae hatch and bore immediately through the bark to feed on the vascular tissues. The life cycle takes one to two years to complete.

Pest Monitoring

See “Woodborers” in:

Common Landscape Pests

Management—biological control

Woodpeckers feed on the larvae during the winter months. Several larval and egg parasitoids have been reported.

Management—cultural control

Birch typically grows in shady, moist environments. When planted in hot, dry environments, the trees can become drought stressed and susceptible to beetle attack. Birch trees that are planted in full sun need more frequent irrigation. Borers are unable to survive in healthy trees. Keep trees vigorous with proper watering, fertilizing, and other cultural practices. In the drier regions of the PNW, plant the more resistant birch varieties and species. Susceptible birch species include Jacquemontii birch, Whitebarked Himalayan birch (*Betula jacquemontii*), European white birch, silver birch (*B. pendula*), European white weeping birch, Young's weeping birch (*B. pendula* 'Youngii'), and ornamental cutleaf varieties of birch. Moderately susceptible birch includes gray birch (*B. populifolia*), whitespire birch (*B. platyphylla japonica* 'Whitespire'), yellow birch (*B. alleghaniensis*), sweet birch, black birch, cherry birch (*B. lenta*), paper birch, white birch, and canoe birch (*B. papyrifer*). Those with low susceptibility (more resistant) include heritage birch, heritage river birch (*B. nigra* 'Heritage'), river birch and red birch (*B. nigra*). Do not prune when adults emerge and seek oviposition sites (late April to mid-July) as the females are attracted to fresh cuts.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Birch (*Betula*)—Carpenterworm

Prionoxystus robiniae

Pest description and damage Carpenterworms are the larvae of a large, mottled gray and black moth whose size ranges from 1.75 to 3.0 inches in length. The caterpillars are white to pinkish red with a dark head and are 1 to 3 inches long when mature. The caterpillars bore in the trunk and main branches. Discolored or bleeding limbs, branch dieback, and lumpy or gnarled trunks may be indications of carpenterworm infestation. Typical symptoms of a carpenterworm infestation include sawdust-like material (frass) and wood chips mixed with loose webbing on or around infested trees. Trees with severe carpenterworm infestations are susceptible to wind breakage and should be removed for safety reasons.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Carpenterworm

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Birch (*Betula*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inches in length, covered with yellow, rusty, or black colored silky hairs. Adults have a 1-inch wingspan and are bright white with orange and black markings on the underside of the abdomen. Whitish moth scales cover and protect masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:
Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Birch (*Betula*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature scale is approximately 0.125 inch in length, hard-shelled under a brown, or gray scale, and usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs of many broad-leaved deciduous plants. They occur

less frequently on the leaves and other plant parts. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Newly emerged crawlers look like bright white pimples on the bark.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Oystershell scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Birch (*Betula*)—Sawfly

Birch sawfly (*Arge pectoralis*)
Dusky birch sawfly (*Nematus latitarsus*)

Pest description and damage Mature birch sawfly larvae are yellowish with rows of black spots along the abdomen and 0.75 inch in length. The head is reddish yellow with black eyespots. Adults are about 0.3 inch long, have 3-segmented antennae and lay eggs in rows on the edges of leaves. Larvae feed on birch, alder, and willow. Usually, damage is localized and rarely does larval feeding cause significant defoliation. Mature larvae of the dusky birch sawfly are about 0.5 inch in length, darker yellowish green, with three dark spots on each segment. They also feed on birch, but usually cause only localized damage. Larvae feed gregariously along the leaf edge holding with their abdomen flipped upside down over their back. Adults are 0.5 inch in length and resemble small wasps. There are two generations of dusky birch sawfly: spring and fall. However, they overwinter in the soil as pupae with adults emerging in spring.

Management—cultural control

Watch for small larvae along the leaf edge in spring. Prune out leaf or area with larvae.

Management—biological control

Stink bugs and other predator bugs have been known to prey upon the larvae.

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

For more information

See "Sawfly" in:

Common Landscape Pests

Furniss, R.L. and V.M. Carolyn. 1980. Western Forest Insects. USDA Forest Service, Misc. Pub 1339.

Birch (*Betula*)—Tent caterpillar

Forest tent caterpillar (*Malacosoma disstria*)
Western tent caterpillar (*Malacosoma californica*)

Pest description and damage The western tent caterpillar attacks a wide variety of plants including alder, ash, birch, cottonwood, and willow as well as fruit trees and roses. The over 1-inch-long adult moths are attracted to lights at night. Mature western tent caterpillars can reach a length of about 2.0 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.625 inch in length, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

For biology, life history, monitoring and management

See:

Alder (*Alnus*)—Tent caterpillar

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Black locust (*Robinia*)—Aphid

Cowpea aphid (*Aphis craccivora*)

Pest description and damage These aphids range in size from 0.05 to 0.08 inches in length and vary in color progressing from light greenish-gray through darkening shades of green to shiny black as they molt. The four molts leave abundant white cast skins among the living aphids and honeydew. Feeding results in puckering, stunting, and curling leaves, and pods, covered with copious sticky honeydew and sooty mold.

Biology and life history Overwintering eggs hatch on alternate hosts such as alfalfa in spring. Shortly after, alates (winged females) fly to black locust and other hosts. Parthenogenetic females lay over one hundred eggs and there may be up to twenty generations.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Black locust (*Robinia*)—Locust borer

Megacyllene robiniae

Pest description and damage The adult locust borer is a conspicuous and brightly colored beetle. Its jet-black body is encircled in yellow bands, with a distinctive W-shaped band extending across the wing covers. The adult is about 0.75 inch in length with reddish legs and black antennae. Locust borer larvae are white and legless, reaching a maximum length of about 1 inch. Locust borer larvae tunnel within limbs to weaken trees, rendering them susceptible to wind breakage and retarding growth. Severe infestations of locust borer result in many dead and broken limbs, along with swollen areas on the tree trunks.

Biology and life history Adult beetles emerge through the holes of host trees. They lay eggs under the tree bark scales and around wounds. Eggs hatch in a week and the larvae prepare a hibernaculum in which they spend winter. In the spring, larvae bore into the woody parts of trees, frequently penetrating the heartwood. Throughout the spring and summer, larvae enlarge their feeding tunnels to 3 to 4 inches in length and about 0.25 inch in diameter. Tunnels initially are formed in an upward and inward direction from the point of entrance, then angle sharply down the trunk, resulting in an L-shaped tunnel.

Pest monitoring Look for branch breakage during winds or branches with knotty swellings. In spring when buds swell, look for wet bark and sap flow as larvae tunnel under the bark. By midsummer, white sawdust-like frass is pushed out through holes in the bark as the larvae tunnel in the sapwood, and later, as they bore into the heartwood, the frass is yellow sawdust. Sawdust frass may accumulate at the base of infested trees.

Management—cultural control

Keep trees vigorous. Remove infested trees that harbor the larvae. Water-stressed trees also may be highly susceptible to attack; thus, watering trees during times of drought may increase their resistance.

Management—biological control

This is an introduced species; no information on biocontrol is listed, but birds and parasitoids are likely possibilities.

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Black walnut (*Juglans*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inches in length, covered with yellow, rusty, and black colored silky hairs. Adult moths have a 1-inch wingspan and are bright white with orange and black markings on the underside of the abdomen. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Boxelder (*Acer negundo*)—Western boxelder bug

Boisea rubrolineata

Pest description and damage The adult boxelder bug is a red, flat, and elongate bug about 0.5 inch in length. The front wings and thorax are gray-black to black with thin bright red markings. The eggs are red. The bright red nymphs look like the adult but without wings and smaller. Damage to host plant seed is minimal since damaged seeds are shed later in the season. The major objection to these bugs is that they congregate in clusters on the outside walls, and then invade the home in fall and spring. They are found in large aggregations on the seeds of boxelder, and to a lesser extent maple and ash. They are known to feed on developing apples, pears, grapes, peaches, plums, and cherries when their populations are high.

Biology and life history The boxelder bug adults overwinter in cracks and crevices, or under siding of houses or in other protected sites. They may emerge on sunny days in winter. In spring, the boxelder bugs adults move from their protected areas and lay red eggs in bark crevices of host trees. Both adults and nymphs feed on leaves, flowers, fruit, and small twigs until they move to the seeds. There is only one generation per year.

Pest monitoring Check new growth on trees or use a beating sheet and dislodge the boxelder bugs.

Management—cultural controls

Remove female boxelder bugs where they congregate. Seal cracks and crevices on houses to keep bugs out.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Boxwood (*Buxus*)—Boxwood leafminer

Monarthropalpus flavus

Pest description and damage The adult is a small (0.1 inch in length) orange to yellow fly which emerges in early May. Eggs are laid and the larval stage begins to mine the tissue of leaves. The boxwood leafminer is a small yellow to orange maggot found inside the mined leaves. Leafminers feed by removing green tissue from between the upper and lower leaf surfaces. Feeding by leafminers can be detected by the presence of yellow to brownish blotch-like mines or by a blistered, thickened appearance to the upper surface of leaves. Damage is mainly aesthetic, but repeated severe infestations may damage shrubs.

Biology and life history The insect overwinters as larvae in the mined leaves. In spring, they become active and grow rapidly. The orange pupae can be seen clinging to the leaf before the adult fly emerges. Female flies lay eggs on the upper surface of the current season's growth. The larvae hatch and mine the leaves through the summer. There is one generation per year.

Management—cultural controls

Pick off infested leaves or shear infested terminals before the flies emerge. Remove and destroy the clippings. Plant resistant varieties include 'Suffruticosa,' 'Pendula,' and 'Argenteo-variegata.'

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more information

See "Leafminer" in:
Common Landscape Pests

Boxwood (*Buxus*)—Boxwood psyllid

Spanioneura buxi

Pest description and damage This distinctive green adult psyllid is about 0.125 inch in length and has an orange abdominal tip. Adult psyllids resemble aphids but can jump and fly. The immature psyllids (nymphs) are covered with a white, waxy secretion that gives them a cottony look. The nymphs feed on the developing buds and new growth. The cupping of leaves at the tips of terminals is a common symptom of psyllid infestation. Buds in cupped leaves often are dead.

Biology and life history The insect overwinters as spindle-shaped orange eggs under bud scales on boxwood. As the buds open in early April, the eggs hatch and the nymphs begin to feed. Adults are found by late May. There is only one generation per year.

Management—biological control

Lady beetles, lacewings, and parasitic wasps are all effective controls for this pest. Avoid the use of broad-spectrum sprays that would disrupt these controls.

Management—cultural control

English boxwood (Buxus sempervirens) is reportedly less susceptible.

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Boxwood (*Buxus*)—Boxwood spider mite

Eurytetranychus buxi

Pest description and damage The adult is around 0.015 inch in length, and a greenish to brown mite. Their feeding causes small whitish, yellowish, or bronze streaks that look like pinpoint stippling on the upper leaf surface. Heavy infestations can cause premature leaf drop. Damage is common throughout the Willamette Valley and in the hotter, drier areas of the PNW.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Boxwood (*Buxus*)—Holly scale

Dynaspidiotus britannicus

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The holly scale insect is a small (0.04 inch in diameter) oval scale, light brown to tan in color. The adult female is lemon yellow. Scale feeding can cause the upper surface of the leaves to become mottled and plant defoliation may occur. Heavily infested plants can be coated with honeydew on which black sooty mold develops. Heavy infestations can weaken plants and make the holly useless as holiday greens.

Biology and life cycle This insect overwinters as an immature scale. In spring, the nymphs mature and begin feeding in late March or early April. The adult males emerge from under their scales and fly to find the adult females in May. Eggs are laid in early- to mid-summer. Around two weeks later the eggs hatch and begin to disperse to foliage throughout the tree. There is only one generation per year.

For monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Butterfly bush (*Buddleja*)—Earwig

Primarily European earwig (*Forficula auricularia*)

Pest description and damage This introduced, nocturnal insect can devastate seedlings, flowers, leaves, and fruit. Adults are brown in color and roughly 0.5 inch in length. Easily recognized by the hind pinchers, called cerci, they are reviled by gardeners. The adults are winged, but the hind wings are folded under the short and stubby forewings. Immature earwigs resemble adults but are smaller, lack wings, and may be paler in color. However, earwigs also can be beneficial by feeding on aphids and other small insects. They also scavenge dead bugs and plant debris, or feed on live plant tissue. Earwigs chew irregular, variable-sized holes in leaves. Earwigs are often worse in dry eastern climates or in dry years.

For biology, life history, monitoring and management

See "Earwig" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Butterfly bush (*Buddleja*)—Root weevil

Numerous species

Pest description and damage Identification is important: species differ in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles between 0.2 and 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size. They rarely damage plants in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 5 in:

Chemical Control of Landscape Pests

California lilac (*Ceanothus*)—Ceanothus leafminer

Tischeria ceanothi

Pest description and damage Tiny (around 0.2 inch in length) drab grayish moths may be seen flying in clouds around plants. They lay eggs on leaves. The tiny leafminer eats into the leaves and feeds between the upper and lower leaf surfaces. Damage can be rather inconspicuous when damage is light. Occasionally all the leaves turn brown, and the plant appears to have died; however, new leaves will eventually emerge.

Biology and life history Moths emerge in May, and immediately mate and lay eggs on leaves. Larvae feed inside the leaf; and from time to time the larvae open a small hole in the leaf and eliminate the frass from the mine. There may be more than one generation per year.

Pest monitoring Watch for clouds of adults in May to minimize damage to plants. Check plants to monitor for damage. If some damage is noted, check more frequently.

Management—cultural control

Shear back plants to remove leaves when larvae are in the mines. Do not compost or the adult moths may still emerge.

Management—biological control

Outbreaks are rare, but do occur. Usually by the time there are large numbers of leafminers, natural enemies build up, and the population crashes. The principal enemy is a eulophid wasp, *Pnigalio flavipes*. Various species of spiders, *Araneus diadematus, Philodromus dispar, Metaphidippus manni,* and a bird, the dark eyed junco, prey on adults. Emerging adults were also trapped and killed in spittlebug (*Clastopera* spp.) froth.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

For more information

See "Leafminer" in:

Common Landscape Pests

Fasoranti, J. O. 1984. The life history and habits of a Ceanothus leafminer, *Tischeria immaculata* (Lepidoptera: Tischeriidae). Canadian Entomologist. 116(11): 1141-1148.

Fasoranti, J.O. 1984. Mining of *Tischeria immaculata* (Braun) (Lepidoptera: Tischeriidae) in the leaves of Ceanothus griseus. Journal of Economic Entomology. 77(5):1127-1129.

California lilac (*Ceanothus*)—Root weevil

Numerous species

Pest description and damage Identification is important: species differ in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles between 0.2 and 0.25 inch long, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size. The Larvae are rarely a significant problem in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 5 in:

Chemical Control of Landscape Pests

California lilac (*Ceanothus*)—Whitefly

Family: Aleyrodidae

Pest description and damage Whitefly species occasionally develop large populations on ceanothus, yet damage is surprisingly insignificant. As the name implies, adult whiteflies are tiny white flies about 0.05 inch in length and often take flight from the host when approached. When the whitefly numbers build, it is often on the south side of plants. Depending on conditions, the population may crash without intervention.

For biology, life history, monitoring and management

See "Whitefly" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

Flint, M.L. 2015 rev. Whiteflies. http://ipm.ucanr.edu/PMG/PESTNOTES/pn7401.html

Camellia (*Camellia*)—Black citrus aphid

Aphis (*Toxoptera*) *aurantii*

Pest description and damage This aphid is 0.1 inch in length, usually shiny black, but also may be dull black to mahogany. It is found on new growth or on winter buds. Infestations may be severe in any season and are often a problem on plants growing in protected places. Aphids tend to feed in colonies and found on the most succulent plant tissues. Feeding damage to shrubs, trees and mature plants is usually minor, but can compromise the vigor of buds and expanding tissues.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Camellia (*Camellia*)—Brown soft scale

Coccus hesperidum

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Brown soft scales are flat, yellowish to dark brown, somewhat mottled insects that range from 0.1 to 0.2 inches in length. They are found on twigs, although young scales also may be found on the foliage, typically on the underside of leaves and along veins. Scale insects suck plant sap and produce copious honeydew on which sooty mold may grow. Brown soft scale has a wide host range. There are multiple generations per year.

Management--biological control

There are numerous parasitoids that control this scale if left alone. Occasionally an outbreak occurs, but parasitoids will find it and the population will crash.

For biology, life history, monitoring and management

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

Anon. 2008. UC Pest Management Guidelines for managing brown soft scale on citrus (http://www.ipm.ucdavis.edu/PMG/r107301311.html)

Camellia (*Camellia*)—Cottony camellia scale

Pulvinaria floccifera

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant

preferences. The most visible stage of the cottony camellia scale insect is the adult female that resembles a flat, 0.125-inch diameter scale often found on the underside of a leaf. Emerging from beneath the adult female is an oblong cottony white egg mass that can be up to twice the length of the adult scale. The cottony camellia scale (sometimes called taxus scale) crawlers are flat brownish or yellowish sucking insects. Foliage with scale infestations may turn yellowish or pale in color. Due to copious honeydew, leaves below are covered with a crust of black sooty mold. The cottony camellia scale also is found on English ivy, yew, euonymus, holly, hydrangea, maple, mulberry, pittosporum, rhododendron, and yew. It is possible to have low numbers of this insect for years without an outbreak.

Biology and life cycle This scale overwinters as nymphs on twigs of the leaves. In the spring, adult females lay cottony egg masses about 0.25 inch long on the underside of leaves. The eggs hatch, and the crawlers settle on the leaves along the veins to feed. There is one generation per year.

Pest monitoring Look for scale insects on the undersides of leaves above surfaces covered with honeydew and black sooty mold. Host plants may have continuous low numbers of scales or be patchy in distribution on the plant. Check for natural enemies, or evidence of parasitized scales.

Management—biological control

Small birds and parasitoids feed on the scale insects. It is likely that natural enemies account for the low number of scales year after year on observed plants. Low numbers of cottony camellia scale do little harm to plants but provide parasitoids with a steady source of prey. Periodically, an outbreak of this scale may require control.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

See "Scale insect" in:
Common Landscape Pests

Camellia (*Camellia*)—Root weevil

Numerous species

Pest description and damage Identification is important: species differ in susceptibility to pesticides. Adult weevils are small dark nocturnal beetles with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

See Table 5 in:
Chemical Control of Landscape Pests

Cherry, flowering (*Prunus*)—Aphid

Black cherry aphid (*Myzus cerasi*)
Rusty plum aphid (*Hysteroneura setariae*)

Pest description and damage The black cherry aphid is a shiny black aphid species whose size ranges from 0.07 to 0.12 inches in length. This species produces winged adults that migrate to summer hosts in the mustard family. The rusty plum aphid is rusty brown or deep purple with white bands on the legs and size ranges from 0.05 to 0.08 inches long. Winged adults of this species migrate to corn, grasses, and Virginia creeper during the summer. Many other aphid species may infest cherry trees. Aphid feeding can cause the host leaves to become curled and distorted.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Cherry, flowering (*Prunus*)—Apple-and-thorn skeletonizer

Choreutis pariana

Pest description and damage Adult moth is reddish brown, with a wingspread less than 0.5 inch, and irregular light and dark bands on the wings. Larvae are 0.5 inch in length, yellowish to greenish, with black spots and a yellow-brown head. Pupae are yellow to brown with a white silken cocoon. The larvae skeletonize and roll leaves from the edge and tip. Damaged leaves are brown and papery and drop prematurely. Damage varies

from inconsequential to serious, so monitoring is an important management tool.

For biology, life history, monitoring and management

See:

Crabapple (*Malus*)—Apple-and-thorn skeletonizer

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Cherry, flowering (*Prunus*)—Cherry bark tortrix

Enarmonia formosana

Pest description and damage Cherry bark tortrix (CBT) occurs in Eurasia, Africa, and North America. CBT was first discovered in North America in British Columbia in 1989. By 1998, CBT was found in the Pacific Northwest as far south as Centralia, WA. CBT is slowly moving southward. Eastern movement has not been seen—possibly due to the Cascade Mountain range. Conditions in eastern Washington may not be favorable for CBT to survive except in protected riparian areas. CBT is a pest of most woody ornamental trees and shrubs in the family Rosaceae. The larvae are 0.33 to 0.4 inch in length, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a yellowish-brown head. Larvae feed directly on the cambium under the bark of the tree and may cause death of the tree. Otherwise, the feeding activity decreases the supply of nutrients to the tree and increases susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the exuding of reddish-brown gum-like resin, which often is mixed with fecal pellets and silk. The trunk and larger limbs of bearing fruit trees are affected, usually at pruning wounds. The adult moth has a wingspan of about 0.33 inch and is a mottled yellow, cream and brown in appearance.

Biology and life history CBT larvae overwinter under bark. During spring, they resume feeding and eventually pupate in a silken tube that protrudes beyond the bark surface where they were feeding. Adults fly from late April to September and are most active in the early morning; some may be attracted to lights at night. Eggs are laid on tree bark, in crevices, or under loose bark, primarily at wounds (mechanical or old infestations). Eggs are placed singly or in overlapping groups of two or three and hatch in two to three weeks. Hatching larvae penetrate the bark through openings (natural and mechanical wounds) and feed on the living tissue of the tree's bark. Graft unions of ornamental trees are preferred sites for attack. Larvae do not penetrate the hardwood of the tree. During feeding, CBT larvae construct a frass tube consisting of fecal pellets and webbing. The tubes are about 0.25 inch in length and look soft, as if they are made from sawdust. The frass tubes of the larvae and pupae are usually concentrated around the base of the trunk, where a branch and trunk meet and at graft unions.

Scouting and thresholds Frass tubes are an excellent indication of CBT infestations, and susceptible trees should be monitored regularly. Since other insects can cause similar damage, inspection of the larvae is required for confirmation.

Management—biological control

Although some wasp species parasitize the larvae, effective biological control does not occur at present. Avoid sprays that will disrupt whatever control does occur.

Management—cultural control

Avoid unnecessary pruning cuts or injuries to the tree. Like most wood-boring insects, CBT is attracted to stressed trees. Keep trees as healthy as possible with appropriate watering, fertilizer applications, and pruning. Remove heavily infested branches or trees.

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

For more information

Beers, E. H., M.W. Klaus and E. LaGasa. 1993. Cherry bark tortrix (https://treefruit.wsu.edu/crop-protection/opm/cherry-bark-tortrix/)

Tanigoshi, L.K., B. S Gerde, and T. A. Murray, T. 2015. Pest watch: Cherry bark tortrix. WSU Extension FS155E. (https://research.libraries.wsu.edu)

Cherry, flowering (*Prunus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inches in length, covered with yellow, rusty then black colored silky hairs. Adult moths have a 1-inch wingspan and are

bright white with orange and black markings on the underside of the abdomen. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Cherry, flowering (*Prunus*)—Peachtree borer

Synanthedon exitiosa

Pest description and damage Peachtree borer is native to North America and common in the Pacific Northwest. The adult is a metallic blue-black, clearwing moth. The male moth with a 1-inch wingspan may have bands of light-yellow scale on the abdomen, which make it resemble a wasp. The female has a 1.5-inch wingspan and an orange band around the abdomen. Full-grown larvae are 1 inch in length and whitish with a brown head. The larvae burrow into the bark of the crown and feed on the cambium. Feeding is restricted to an area a few inches above and below the soil line. Peachtree borer damage can girdle and kill young trees. Older trees are rarely girdled, but the feeding reduces vigor and makes them vulnerable to other pests and diseases. Infested trees bleed a reddish amber, frass, and gum mixture during the growing season.

For biology, life history, monitoring and management

See:

Peach, flowering (*Prunus*)—Peachtree borer

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Cherry, flowering (*Prunus*)—Oblique-banded leafroller

Choristoneura rosaceana

Pest description and damage The oblique-banded leafroller larvae roll and tie leaves together for shelter and feeding. The newly hatched larva first mines the leaves, then rolls, and ties the leaves together. Often, they are detected by the abundant holes in leaves. The larvae are green caterpillars with a light brown to black head. Mature larvae range from 0.75 to 1.0 inch in length. When disturbed, they thrash about violently, wriggle backwards and, and may drop from the leaf suspended by a silken thread. Their feeding on growing points on young plants can promote undesirable branching. Adults of the oblique-banded leafroller are bell-shaped, up to 1 inch in length, tan to brown, with broad bands on the wings. Females lay overlapping masses of green eggs on the bark.

Biology and life history The oblique-banded leafroller overwinters as immature larvae under the bark on scaffold branches of a variety of host plants. Larvae may feed during warm periods in winter but become active with warming spring weather and the onset of new growth. They feed for several weeks, and then pupate in rolled leaves. Adult moths emerge in late June or early July. These lay eggs for the second generation. The second generation hatches in early July and does the most damage.

Pest monitoring Start sampling for leafrollers in mid-April. Examine the terminal clusters for tightly rolled leaves and feeding damage on new growth. Watch for the first holes to appear and search nearby folded leaves for larvae, moth exit holes or evidence of larval silk used to hold the rolled leaf together.

Management—cultural control

Hand-pick rolled leaves containing larvae or pupae. Removal of overwintering sites, such as rolled leaves on the ground or plastered to plants, can reduce next year's population.

Management—biological control

Very low temperatures in winter significantly reduce overwintering populations of larvae. Spiders and parasitic wasps, as well as predators like birds and the brown lacewing, greatly reduce leafroller populations throughout the year. There are parasitoid wasps that specialize in leafrollers.

Management—chemical control

See Table 3:

Chemical Control of Landscape Pests

For more information

See "Leafroller" in:

Common Landscape Pests

Cherry, flowering (*Prunus*)—Pear sawfly (pear slug)

California pear sawfly (*Pristiphora abbreviata*)
Pear slug (*Caliroa cerasi*)

Pest description and damage Pear slug is a European insect now found in most areas of the U.S. It attacks both pear and cherry and is found on rosaceous hosts. The adult is a glossy black wasp-like fly, about 0.2 inches in length. The larva initially resembles a small tadpole due to the olive-green slime that covers the body, and the head being wider than the rest of the body. Mature larvae are 0.38 inch in length and orange yellow. Larvae feed on the upper surface of leaves, skeletonizing them. Heavy feeding causes leaf drop, reduction in vigor and yield, particularly on young trees. California pear sawfly is found occasionally defoliating pear trees. Larvae eat round holes in leaves. After extensive feeding, only the midrib remains. The larvae are bright green, closely matching the leaf color; they rest along edges of the damaged area. This pest can severely defoliate ornamental pears.

For biology, life history, monitoring and management

See:

Pear, flowering (*Pyrus*)—Pear sawfly (pear slug)

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Cherry, flowering (*Prunus*)—Western red-humped caterpillar

Oedemasia salicis

Pest description and damage The western redhumped caterpillar is the larva of a 1.0-inch, gray-brown moth. The mature larvae can be up to 1.25 inches in length and are yellow with a red head and the fourth segment is humped. The body has orange, black, and white lengthwise stripes with dark fleshy "spikes." Young redhumped caterpillars are found in clustered colonies that disperse as they mature. They eat entire leaves (except the major veins) and can cause considerable defoliation. This insect has been a problem in cherry, rose, and other hosts east of the Cascade Mountains.

Management—cultural control

Individual larvae may be picked off, and entire colonies can be cut out.

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:

Common Landscape Pests

Cherry, flowering (*Prunus*)—Root weevil

Various species

Pest description and damage Identification is important as root weevil species differ in susceptibility to pesticides. Adult weevils are from 0.2 to 0.75 inch in length dark nocturnal beetles with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size. The larvae are rarely a significant problem in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 5 in:

Chemical Control of Landscape Pests

Cherry, flowering (*Prunus*)—Rose leafhopper

Includes *Edwardsiana rosae*

Pest description and damage Rose leafhoppers are small (0.14 to 0.16 inch in length), active, whitish-green insects which hop when disturbed. The nymphs (immatures) are white with red eyes. Rose leafhoppers feed on the surface of leaves, causing white or pale blotches of dead cells that resemble spider mite stippling. Injured leaves may drop prematurely. Eggs are laid in the fall, which also wounds the canes, providing entry points for fungal pathogens. Cast skins are found on the underside of leaves. Leafhopper damage is mainly aesthetic. They are distinguished by their ability to run quickly forwards, backwards, or sideways to escape danger. Some leafhoppers transmit plant diseases. Sometimes leafhopper damage will

cause the tips of leaves die and turn brown. Some leafhoppers exude copious amounts of honeydew that can result in sooty mold.

For biology, life history, monitoring and management

See:

Rose (*Rosa*)—Rose leafhopper

See "Leafhopper" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Cherry, flowering (*Prunus*)—San Jose scale

Quadraspidiotus perniciosus

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The San Jose scale was introduced to the U.S. on flowering peach in the 1870s. It is now a pest of all fruit trees and many ornamental and wild trees and shrubs throughout the U.S., particularly in hot, dry climates. San Jose scale is differentiated from other scale insects by the scale (shell) that covers the adult females. The scale is about 0.06 inch in diameter, hard, gray to black, and cone-shaped, with a tiny white knob in the center. There is a series of grooves or rings around the white knob, and a purple halo on the bark around the scale.

Biology and life history The San Jose scale overwinters in an immature state under black shells. In spring, the tiny, winged males emerge and mate with wingless females still under their scales. Females give birth to live young about a month later (no eggs). Young scale insects, or "crawlers," are very small, flattened, and yellow, and move around on bark and foliage before settling down to feed. A few days later, they secrete a waxy coating over their body for protection. From this point, female scales will not move. Crawlers are present during June and July and again in August to September. There are two generations per year.

Pest monitoring Inspect twigs for these scales during the dormant season when bark is more visible. Pay attention to weak plants. Observe the young bark for purplish-red halos, which indicate infestation. In cherry orchards, scale-infested leaves of trees do not drop in fall, making scale detection straightforward. Bark of infested trees becomes rough in texture (healthy bark even on older trees is smooth). The crawlers are observed during June to July with a 10X magnifying glass. Crawlers are monitored by wrapping a piece of black sticky tape around an infested branch with the sticky side out. Pheromone traps will trap males to provide early warning and there is a degree-day model for predicting when crawlers will emerge.

Management—cultural control

Ensure ample water and cultural care with proper pruning cuts and management.

Management—biological control

Several parasitoids attack this scale. In fruit orchards, these parasitoids have not kept San Jose scale populations in check. In home orchards, where pesticides are used sparingly, the parasitoid has been more effective.

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

For more information

See "Scale insect" in:

Common Landscape Pests

Cherry, flowering (*Prunus*)—Shothole borer

Scolytus rugulosus

Pest description and damage The adult shothole borer is a brownish-black beetle about 0.08 inch in length. The larvae are white, legless, and about 0.16 inch long. When the numerous beetles emerge, the bark takes on a shothole appearance. These beetles are primarily a problem on injured or stressed plants, but healthy trees growing adjacent to blocks of neglected trees are attacked.

For biology, life history, monitoring and management

See "Bark beetle" in:

Common Landscape Pests

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Cherry, flowering (*Prunus*)—Spider mite

European red mite (*Panonychus ulmi*)
Twospotted spider mite (*Tetranychus urticae*)

Pest description and damage Several species of spider mites can cause damage to flowering cherries. Appearance of these mites varies with the species, although all spider mites are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Twospotted mites are oval and yellowish-brown or green with distinctive black spots on the body. Mites damage leaves and fruit indirectly by feeding on leaves, which causes leaf stippling, bronzing, and possibly drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Cherry, flowering (*Prunus*)—Tent caterpillar

Forest tent caterpillar (*Malacosoma disstria*)
Western tent caterpillar (*Malacosoma californica*)

Pest description and damage The western tent caterpillar attacks a wide variety of plants including alder, ash, birch, cottonwood, and willow as well as fruit trees and roses. The over 1-inch adult moths are attracted to lights at night. Mature western tent caterpillars can reach nearly 2 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.625 inch in length, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

For biology, life history, monitoring and management

See:
Alder (*Alnus*)—Tent caterpillar

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Chestnut (*Castanea*)—European shothole borer

Anisandrus (*Xyleborus*) *dispar*

Pest description and damage Shothole borers are small bark beetles that often attack weakened branches. *Anisandrus dispar* is the primary shothole borer infesting chestnut in the PNW. When the numerous beetles emerge, the bark takes on a shothole appearance. These beetles are primarily a problem on injured or stressed plants, but healthy trees growing adjacent to blocks of neglected trees are attacked. The adult shothole borer is a brownish-black beetle about 0.08 inch in length. The larvae are white, legless, and about 0.16 inch long.

For biology, life history, monitoring and management

See "Bark beetle" in:
Common Landscape Pests

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Cotoneaster (*Cotoneaster*)—Aphid

Includes
Apple aphid (*Aphis pomi*)
Potato aphid (*Macrosiphum euphorbiae*)

Pest description and damage Several species of aphids may feed on the foliage, stem, and flower clusters. Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. The potato aphid is green, yellow, or pink in color and has long dark-tipped cornicles ("dual exhaust pipes"). The winged adults are yellowish with whitish wings. These potato aphids cause the leaves toward the tips of the twigs to turn yellow and twist. They also are a serious pest in the vegetable garden so controlling the aphids on cotoneaster may reduce problems elsewhere. The apple aphid (often called the green apple aphid) is primarily a pest of apples, but affects other rosaceous hosts. Apple aphid is a tiny green aphid with visible cornicles. The winged form has a darker thorax, greenish abdomen, and whitish wings. This aphid feeds in clusters on leaves and around the developing fruit. Aphids produce copious amounts of honeydew that gardeners find objectionable.

For biology, life history, monitoring and management

Both aphids appear in the spring when cotoneaster is blooming, so take care to choose a pesticide that is harmless to bees.

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Cotoneaster (*Cotoneaster*)—Cotoneaster webworm

Athrips rancidella

Pest description and damage The cotoneaster webworm is a dark brown caterpillar, 0.25 to 0.5 inch in length. It typically webs leaves together and feeds within tubes snaking along the branches. Besides unsightly webbing, larvae skeletonize leaves. Death of branches can occur. The webworm is primarily a problem on *Cotoneaster horizontalis* (rock cotoneaster) and only in some years.

Biology and life history The caterpillars feed during the summer and fall, overwintering in nests on the plant. They pupate in the spring giving rise to dark gray, night-flying adult moths. Eggs are laid in spring.

Pest monitoring Search for webbing that follows along the main branches among the leaves.

Management—cultural control

Hand-pick and destroy larvae; prune out nests.

Management—biological control

The fact that populations rise and fall indicate that natural enemies are present in most years.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Cotoneaster (*Cotoneaster*)—Spider mite

Includes twospotted spider mite (*Tetranychus urticae*) and others

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen, and coniferous ornamentals. Appearance of these mites varies with the species, although all are 0.02 inches or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Twospotted mites are oval and yellowish-brown or green with distinctive black spots on the body. Mites damage leaves and fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor.

For biology, life history, monitoring and management

See "Spider mite" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Cottonwood (*Populus*)—Aphid

Includes
Poplar petiole gall aphid (*Pemphigus populitransversus*)
Pemphigus populicaulis

Pest description, damage, biology, and life history There are numerous aphid species on cottonwood. Some cause galls on the midrib or petiole, others feed on leaves. Some of the aphids have alternate hosts on crops such as lettuce or on weeds. Pemphigus aphids can be distinguished from other aphids by their short antennae (less than one-third body length) and undeveloped cornicles. Adult aphids within the galls and migrating adults are from 0.06 and 0.1 inch in length. Gall aphids feeding at the base of leaf petioles cause the petioles to enlarge and enclose the insects. Hard, pale green, rounded galls form along the petiole or at the base of the leaf. Aphids found inside the galls look grayish and waxy. The leaves are not damaged, but may twist at right angles to the petiole. They develop into adults and reproduce once on poplar before migrating to summer hosts in *Brassica* or *Aster* species. In late summer, winged forms reappear, and these migrate back to poplar to mate and lay eggs.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Cottonwood (*Populus*)—Azalea bark scale

Eriococcus azaleae

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Immature azalea bark scales superficially resemble mealybugs in appearance. Mature female scales are about 0.125 inch long and appear like white cottony sacs, often located on twigs and stems of azalea, especially in branch axils. Eggs, crawlers, and adults beneath the wax scales are red. Hosts include andromeda, azalea, rhododendron, hawthorn, poplar, willow, and most recently, blueberry in the Pacific Northwest.

For biology, life history, scouting, and management options

See:
Azalea (*Rhododendron*)—Azalea bark scale

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Cottonwood (*Populus*)—Carpenterworm

Prionoxystus robiniae

Pest description and damage Carpenterworms are the larvae of a large, mottled gray and black moth whose size ranges from 1.75 to 3 inches in length. The caterpillars are greenish white to pinkish with a dark head and are 1 to 3 inches long when mature. The caterpillars bore in the trunk and main branches of cottonwood, ash, birch, black locust, poplar, willow, elm, oak, locust, maple, pear and other deciduous trees and shrubs. Discolored or bleeding limbs, branch dieback, and lumpy or gnarled trunks may be indications of carpenterworm infestation.

Biology and life history Adults emerge in late spring and early summer and begin laying eggs. Females lay between 200 to 1000 olive brown eggs during her life, mostly in groups of 2 to 6 eggs. Eggs are found in sticky masses in cracks and crevices of the bark of host plants. After hatching, the larvae bore into the sapwood where they tunnel and feed for up to two to four years before they are mature.

Management—cultural control

Keep trees vigorous, as healthy trees are better able to tolerate some damage. Prevent injuries that attract carpenterworm moths to trees. Poke a wire into tunnels to kill larvae. Prune trees in late fall and winter so that moths are not attracted to fresh wounds. Remove infested branches.

Management—biological control

Apply beneficial nematodes (*Steinernema carpocapsae* or *S. feltiae*) into tunnels to kill larvae. Fill tunnels with nematodes in water, then plug holes and wait about a week. It may be necessary to treat tunnels again if plugged holes are reopened by surviving larvae. Natural enemies recorded for this pest include downy woodpeckers, ichneumonid wasps, and fungi.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Cottonwood (*Populus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. As caterpillars mature, they enlarge the tent to enclose multiple branches and even entire trees. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inches in length, covered with rusty colored silky hairs. Adult moths have a 1-inch wingspan and are bright white with orange and black markings on the underside of their abdomens. Whitish moth scales cover masses of 200 to 500 greenish eggs.

Biology and life history Adults emerge over a long period in spring and lay eggs on leaves. Eggs do not hatch until late summer (late July or August). Larvae feed for 4 to 6 weeks and then drop to the ground to pupate in the duff and litter, or cells in the soil.

Pest monitoring Look for small first tents in late summer and control before significant damage is done. Early detection will also provide early indication of whether it is a bumper year for this pest. One or two nests can be ignored on healthy trees, but many nests may require early intervention with biological or other control options.

Management—cultural control

Remove tents as soon as first noticed, place in a bag and squash the nest. Do not burn tents in trees with torches, as this practice has led to house and field fires and burns to humans. Disrupt the integrity of the web by blasting it with a hose or breaking it with a long pole. Keep trees vigorous to reduce impacts.

Management—biological control

There are several natural enemies including yellowjackets, paper wasps, egg parasites and others.

Management—chemical control

See Table 2 in:
Common Landscape Pests

Cottonwood (*Populus*)—Tent caterpillar

Forest tent caterpillar (*Malacosoma disstria*)
Western tent caterpillar (*Malacosoma californica*)

Pest description and damage The western tent caterpillar attacks a wide variety of plants including alder, ash, birch, cottonwood, and willow as well as fruit trees and roses. The over 1-inch-long adult moths are attracted to lights at night. Mature western tent caterpillars can reach a length of about 2 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.625 inch in length, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

For biology, life history, monitoring and management

See:
Alder (*Alnus*)—Tent caterpillar

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Cottonwood (*Populus*)—Satin moth

Leucoma salicis

Pest description and damage The adult moth (over 1-inch wingspan) is satiny white with black markings on the legs. The attractive caterpillars are approximately 2 inches long when grown and reddish brown with double white dorsal patches and tufts of hairs along the sides. They can seriously skeletonize then defoliate cottonwood, poplar, and willow. They occasionally attack other hosts.

For biology, life history, monitoring and management

See:
Poplar (*Populus*)—Satin moth

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Crabapple, flowering (*Malus*)—Aphid

Includes
Apple aphid (*Aphis pomi*)
Spirea aphid (*Aphis spiraecola*)

Pest description and damage Several species of aphids may feed on the leaves, stems, flower buds, bark or root tissues of conifer and deciduous trees, shrubs, as well as other plants in landscapes. Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies (black, green, pink, yellow, mottled, striped, etc.), but most aphids tend to match host plant coloration. Aphids tend to feed in colonies and are found on the new or most succulent plant tissues. Feeding damage to shrubs, trees and mature plants is usually minor, but can compromise the vigor of the host. When aphid populations are high, leaf and shoot distortion can occur. Aphids produce honeydew, a sweet, sticky secretion that collects on underlying plant tissues and encourages growth of a black sooty mold.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Crabapple, flowering (*Malus*)—Apple-and-thorn skeletonizer

Choreutis pariana

Pest description and damage The adult moth is reddish brown, with a wingspread less than 0.5 inch, and irregular light and dark bands on the wings. Larvae are 0.5 inch in length, yellowish to greenish, with black spots and a yellow-brown head. Pupae are yellow to brown with a white silken cocoon. The larvae skeletonize and roll leaves from the sides. Damaged leaves are brown and papery and drop prematurely. They feed on apple, crabapple, cherry, pear, mountain ash, birch, plum, hawthorn and possibly willow, but apple is the preferred host. Damage varies from inconsequential to serious, so early tree monitoring to assess larval numbers is an important management tool.

Biology and life history Adult moths overwinter in crevices in the tree. They lay eggs in small bunches on the undersides of leaves. The larvae emerge and feed on the underside of the leaves, then move to the top surface and feed there. There is often more than one caterpillar in the roll. After three to four weeks, they pupate in the rolled leaf. Adults emerge after about two weeks to start a new generation. There are at least two generations per year.

Pest monitoring Watch for signs of skeletonizing that, from a distance, looks like the leaf tips have been burned. Early scouting will provide adequate time for control if numbers are high.

Management—biological control

There are many natural enemies of this pest. Avoid broad-spectrum sprays that would disrupt this system.

Management—cultural control

Larvae and pupae are removed easily from rolled leaves. Rolled leaves are pinched to kill larvae on small trees. Remove heavily infested twigs.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Crabapple, flowering (*Malus*)—Cherry bark tortrix

Enarmonia formosana

Pest description and damage Cherry bark tortrix is a pest of most woody ornamental trees and shrubs in the family Rosaceae, but cherry is the preferred host. The larvae are 0.33 to 0.4 inch in length, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a

yellowish-brown head. Larvae feed directly on the cambium beneath the bark of the tree. Extensive feeding may cause death of the tree. Otherwise, the feeding activity decreases the supply of nutrients to the tree and increases tree susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the reddish-brown gum-like resin, mixed with fecal pellets and silk, that flows from the bark. The trunk and larger limbs of bearing fruit trees are affected, usually at pruning wounds and graft unions. The adult moth has a wingspan of about 0.33 inch and is a mottled yellow, cream and brown in appearance.

For biology, life history, monitoring and management

See:

Cherry (*Prunus*)—Cherry bark tortrix

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Crabapple, flowering (*Malus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inch in length, covered with yellow, rusty, and black silky hairs. Adult moths have a 1-inch wingspan and are bright white with orange and black markings on the underside of the abdomen. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Crabapple, flowering (*Malus*)—Leafroller

Includes
Fruittree leafroller (*Archips argyrospila*)
Oblique-banded leafroller (*Choristoneura rosaceana*)

Pest description and damage The leafroller pests can be divided into single-generation moths, such as the fruit tree leafroller and the European leafroller, and two-generation moths, such as the oblique-banded leafroller and pandemis leafroller. The larvae are mostly green caterpillars with a light brown to black head. Mature larvae range from 0.75 to 1.0 inch in length. Adults have distinctive bands or mottling on the wings but are rarely seen. The tortricid moth larvae are noted for their violent backward wriggling—a means of escape. Newly hatched larvae also may work into blossoms. The larvae web the leaves and flowers together beginning in late April, and then feed on the developing fruit or flowers. Larvae may also feed on the surface of ornamental fruits or berries. Adult moths are typically over 0.75 inch in wingspan.

For biology, life history, monitoring and management

See:

Cherry, flowering (*Prunus*)—Oblique-banded leafroller

See "Leafroller" or "Caterpillars" in:

Common Landscape Pests

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Crabapple, flowering (*Malus*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature oystershell scale insect is approximately 0.125 inch in length beneath a brown or gray scale that is usually elongated and

slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs of many broad-leaved deciduous plants. They occur less frequently on the surface of leaves and fruit. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Newly emerged crawlers look like bright white pimples on the bark.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Oystershell scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Crabapple, flowering (*Malus*)—Rose leafhopper

Includes *Edwardsiana rosae*

Pest description and damage Rose leafhoppers are small (0.14 to 0.16 inch in length), active, whitish-green insects that run forward, sideways, or backward when disturbed. The nymphs (immature) are white with red eyes. Rose leafhoppers feed on the leaves, causing white or pale blotches that resemble, but are larger than, spider mite stippling. Injured leaves may drop prematurely. The egg-laying in the fall also wounds the twigs, providing entry points for fungal pathogens. Cast skins are found on the underside of leaves. Leafhopper damage is mainly aesthetic, but occasionally severe enough to impact the health of the crabapple tree.

For biology, life history, monitoring and management

See:

Rose (*Rosa*)—Rose leafhopper

See "Leafhopper" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Crabapple, flowering (*Malus*)—San Jose scale

Quadraspidiotus perniciosus

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. San Jose scale is a pest of many ornamental and wild trees in the PNW, particularly in hot, dry climates. San Jose scales can be differentiated from other scale insects by the hard, gray to black, and cone-shaped scale covering the insect. The scale is about 0.06 inch in diameter and has a tiny white knob in the center with a series of grooves or rings around it. Twigs with infested bark are roughened, rather than smooth, and twig death may occur. Often there is a purple halo on the bark around each scale. At high population densities, fruit is also infested and displays these dark halos about the scales. Crawlers are flat and yellow and common in June and again in August to September.

For biology, life history, monitoring and management

See:

Cherry, flowering (*Prunus*)—San Jose scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Crabapple, flowering (*Malus*)—Spider mite

Tetranychus spp.

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen, and coniferous ornamentals. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Twospotted mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants are covered with fine silk webbing at branch axils or over sections, small plants may

be engulfed in webbing under very heavy infestations. Mites damage leaves and fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Crabapple, flowering (*Malus*)—Tent caterpillar

Forest tent caterpillar (Malacosoma disstria)
Western tent caterpillar (Malacosoma californica)

Pest description and damage The western tent caterpillar attacks a wide variety of plants including alder, ash, birch, cottonwood, and willow as well as fruit trees and roses. The over 1-inch adult moths are attracted to lights at night. Mature western tent caterpillars can reach a length of about 2 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.625 inch in length, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

For biology, life history, monitoring and management

See:

Alder (*Alnus*)—Tent caterpillar

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Daffodil (*Narcissus*)—Bulb mite

Rhizoglyphus echinopus

Pest description and damage Mature bulb mites vary in length from about 0.02 to 0.03 inches and have four pairs of legs. Their bodies are shiny, white, somewhat transparent, and smooth with reddish brown appendages. They are found in colonies. Their oval shape and sluggish behavior can deceive the human eye into identifying them as eggs. They avoid the light and hide under damaged or diseased tissue. Bulbs infested with bulb mites may rot and fail to produce new growth, or new growth may be off-color, stunted, and distorted. Although the bulb mite is not a primary pest of bulbs, it is often responsible for serious losses; the slightest injury to a bulb will allow bulb mites to enter and become established. Once the mites are inside the bulb, they rapidly turn the bulbs into rotten pulp. Injured or bruised bulbs are the most susceptible to damage. Not only do mites destroy bulb tissue, but they also carry fungi and bacteria that often result in additional damage. Millipedes may move into the rotting bulbs which confuses the diagnosis. Bulbs planted too late in the season are often heavily infested and dried out by the time they are planted.

For biology, life history, monitoring and management

See:

Tulip (*Tulipa*)—Bulb mite

Daffodil (*Narcissus*)—Bulb fly

Lesser bulb fly (*Eumerus funeralis*)
Narcissus bulb fly (*Merodon equestris*)

Pest description and damage The adult narcissus bulb fly is about 0.5 inch in length and closely resembles a small bumblebee; it can be recognized by its aggressive behavior of bumping into other bees and female bulb flies. The larva is a fat, yellowish-white, wrinkled maggot about 0.75 inch long. The lesser bulb fly adults are smaller at 0.2 inch long and blackish green with white markings on the abdomen; the larvae are smaller and more numerous in the bulbs. The maggots of the narcissus bulb fly burrow into the bulbs near the basal plate and feed inside the bulbs, destroying bulb scale and flower parts while maggots of the lesser bulb fly are thought to be scavengers. Infested bulbs may develop spindly, grassy-looking leaves if the bulb is not too badly damaged. Severely damaged bulbs are soft, brown, and decayed. The narcissus bulb fly attacks amaryllis, galtonia, hyacinth, iris, lily, leucojum, narcissus, scilla, tulip, and vallota. The lesser bulb fly also attacks and may be a primary pest on onions and shallots and other bulbs.

Biology and life history The life histories of the two pests are similar. The females lay eggs near the bulbs during May or early June. The eggs hatch into grubs that move down into the soil and burrow into the base of the bulb to feed there, reducing the bulb's center to a rotten mass. In the process, they destroy the embryonic flowers that unfolded the following spring. After feeding, larvae pupate in the bulb or soil. In the spring, they emerge as adult flies to mate and lay eggs. Lesser bulb fly may have a second generation.

Pest monitoring Check daffodil plantings for spindly, grassy leaves and no flower. Dig up bulbs to inspect for hollowed out bulbs, decay followed by scavengers such as millipedes and sowbugs.

Management—cultural control

Narcissus fly infestations can be avoided by planting bulbs deep in the ground (10 inches). Plant in open areas exposed to wind. Bulb flies are usually less of a problem in such sites. Covering foliage of plants with a row cover after bloom prevents egg-laying. Plant only firm, healthy daffodil bulbs. Soft bulbs are infested from the previous season. Destroy any soft bulbs to prevent the emergence of adult bulb flies. Dig and store bulbs after foliage dries to prevent the bulb fly from laying eggs. A hot water bath has been found to be effective in killing maggots in infested bulbs. Maggots are killed if bulbs are submerged in water kept at about 110°F for 40 minutes. Take care to avoid overheating the bulbs even for a short time as the bulbs may be adversely affected by high temperatures.

Dahlia (*Dahlia*)—Aphid

Bean aphid (*Aphis fabae*)
Green peach aphid (*Myzus persicae*)
Leafcurl plum aphid (*Brachycaudus helichrysi*)

Pest description and damage The aphids tend to be small (.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies between species. Bean aphid is a dull black gregarious aphid; green peach aphid is yellowish green with dark lines; and the leafcurl plum aphid has both green and reddish forms. Aphids tend to feed in colonies and are found on the most succulent plant tissues. Feeding damage is usually minor but can compromise the vigor of the host if aphid populations are high. Aphids produce honeydew that encourages growth of a black sooty mold. Some aphids, such as the green peach aphid, are vectors of plant diseases, particularly viruses. Damage ranges from yellowing and shriveling of leaves to severely and tightly curled leaves, or mottled yellowing of virus symptoms.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

Pappu, Hanu. Sam Smith Endowment: Virus diseases of dahlias. Washington State University. http://dahlia.wsu.edu/

Dahlia (*Dahlia*)—Cutworm

Includes
Large yellow underwing (*Noctua pronuba*)
Variegated cutworm (*Peridroma saucia*)

Pest description and damage Several species of cutworms attack dahlias. These are green, reddish, or black caterpillars up to 0.75 to 1.0 inch in length. Some cutworms feed mostly at the soil surface and may cut off emerging shoots at ground level. Others cut C-shaped swaths from the edges of the leaves. Cutworms are caterpillars in the Noctuid family in the order Lepidoptera (butterflies and moths). The variegated cutworm is commonly found in gardens. The larvae are black and brown with white markings. A new invading species is the large (approximately 2-inch wingspan) yellow underwing, *Noctua pronuba*, with a black stripe along the edge of the yellow hind wing. Cutworm larvae are nocturnal, and their feeding will leave the plant with a ragged appearance. Cutworms leave pellet-shaped droppings on underlying leaves.

For biology, life history, monitoring and management

See "Cutworm" and "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Dahlia (*Dahlia*)—Earwig

Primarily European earwig (*Forficula auricularia*)

Pest description and damage This introduced, nocturnal insect can devastate seedlings, flowers, leaves, and fruit. Adults are brown in color and roughly 0.5 inch long. Earwigs are recognized by the pinchers and are reviled by gardeners when the insect drops out of cut flowers onto a table. The

adults are winged, but the hind wings are folded under the short and stubby forewings. Immature earwigs resemble adults but are smaller, lack wings and may be paler in color. However, earwigs are also beneficial feeding on aphids and other small insects, scavenging dead bugs and plant debris. Unfortunately, earwigs can chew irregular holes in leaves at the base of flower petals and other plant tissues. Earwigs are often worse in dry climates or dry years west of the Cascades.

For biology, life history, monitoring and management

See "Earwig" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Dahlia (*Dahlia*)—Western spotted cucumber beetle

Diabrotica undecimpunctata

Pest description and damage The adult western spotted cucumber beetle is yellowish green, 0.25 inch in length, and has eleven black spots on its wing covers. The adult beetles eat small holes in the leaves. Mature larvae are white, except for the head and last abdominal segment, which are brown giving the appearance that larvae have two "heads." The larvae are about 0.63 inch long. Larvae feed on roots and bore into the base of stems, killing small plants and reducing root mass in mature plants so plants may be stunted.

Biology and life history Cucumber beetles overwinter as fertilized females and are active beginning in early spring. Adults lay eggs at the base of plants. Eggs hatch in seven to ten days, and larvae feed in roots for about three weeks before pupating in the soil. Adults emerge two weeks later and feed on pollen, foliage, flowers, and pods. There are two generations per year.

Management—cultural control

In most years, beetle populations diminish after egg laying and before the emergence of the summer population. Planting is delayed until after the beetles have dispersed and deposited most of their eggs. Individual beetles are picked off.

Management—biological control

Entomopathogenic nematodes directed towards the larvae are effective when soil temperatures are warmer than 53°F.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

Natwick E.T. et al. 2009. Cucurbits: cucumber beetles (http://www.ipm.ucdavis.edu/PMG/r116300511.html).

Daphne (*Daphne*)—Aphid

Includes
Foxglove aphid (*Aulacorthum solani*)
Several other species

Pest description and damage Aphids (roughly 0.10 inch in length) appear in large numbers on *Daphne laureola* in spring and seem to disappear by June. Aphids feed in colonies and are often found on the new or most succulent plant tissues. Feeding damage is usually minor, but can compromise the vigor of the host. When aphid populations are high, leaf and shoot distortion can occur. Aphids produce honeydew, a sweet, sticky secretion that collects on underlying plant tissues and encourages growth of a black sooty mold. In addition to cosmetics, honeydew may become a sticky nuisance.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Daphne (*Daphne*)—Lecanium scale

Includes *Parthenolecanium corni*

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Lecanium scales are most noticed as the females expand in size in the spring. As females swell in the spring, they produce large egg masses under their scales and release considerable honeydew that coats nearby foliage. Female lecanium scales are about 0.13 inch in diameter and

vary from red to dark brown in color. They are oval and raised, resembling small “helmets,” “turtles,” or bumps on branches and stems. Male scales are smaller, flat, and oblong. Crawlers are pale yellow and found on the undersides of leaves.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—San Jose scale

See “Scale insect” in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Dogwood (*Cornus*)—Brown soft scale

Coccus hesperidum

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Brown soft scales are yellowish to dark brown insects (adults are usually darker) that range from 0.1 to 0.2 inches in length. They are found mainly on twigs, and young scales may be found on the foliage, typically on the underside of leaves along the leaf midveins. Scale insects suck plant sap and produce copious honeydew on which sooty mold may grow.

For biology, life history, monitoring and management

See “Scale insect” in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Dogwood (*Cornus*)—Flea beetle

Dogwood flea beetle (*Altica corni*)

Pest description and damage Adults of this pest of red osier dogwood are dark, shiny blue, and about 0.25 inch in length. Larvae are black and about 0.25 inch long at maturity. Adults chew holes in leaves while the larvae feed in groups and skeletonize foliage of red osier dogwood. They are capable of defoliating shrubs, but often they are found in smaller numbers throughout the shrubs. Because red osier dogwood is abundantly planted in riparian zones there is a potential for buildup in these settings.

For biology, life history, monitoring and management

See:

Alder (*Alnus*)—Alder flea beetle

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Dogwood (*Cornus*)—Lecanium scale

Includes *Parthenolecanium corni*

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Lecanium scales are most noticed as the females expand in size in the spring. As females swell in the spring, they produce large egg masses under their scales and release considerable honeydew that coats nearby foliage. The female lecanium scales are about 0.13 inch in diameter and vary from reddish-brown to dark brown in color. The adults are oval and raised, resembling small “helmets,” “turtles,” or bumps on branches and stems. Male scales are smaller, flat, and oblong. Pale yellow crawlers feed mostly on the underside of leaves.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—San Jose scale

See “Scale insect” in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Dogwood (*Cornus*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature oystershell scale is approximately 0.13 inch long beneath a brown, or gray scale that is usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs of many broad-leaved deciduous plants. They occur less frequently on the leaves and other plant parts. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Newly emerged crawlers look like bright white pimples on the bark.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Oystershell scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Dogwood (*Cornus*)—Rose leafhopper

Edwardsiana rosae and other leafhoppers

Pest description and damage Rose leafhoppers are small (0.14 to 0.16 inch in length), active, whitish-green insects that run backward, forward, or sideways when disturbed. The nymphs (immature) are white with red eyes. Rose leafhoppers feed on the leaves, causing white or pale blotches that resemble, but are larger than, spider mite stippling. Injured leaves may drop prematurely. Oviposition in the fall also wounds the twigs, providing entry points for fungal pathogens. Cast skins are found on the underside of leaves.

For biology, life history, monitoring and management

See:

Rose (*Rosa*)—Rose leafhopper

See "Leafhopper" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Dogwood (*Cornus*)—Dogwood sawfly

Macremphytus tarsatus

Pest description and damage Dogwood sawfly is a recent introduction to the Pacific Northwest. They are found feeding on red osier dogwood (*Cornus sericea)*. Eggs are small bumps under the epidermis of leaves. Newly hatched larvae are yellow green. The next instar is covered with a white waxy material that is shed with the final molt. Third instar larvae are yellowish green with rows of bold square dark spots along the body. Mature larvae are about 1 inch in length. Entire large red osier dogwoods are defoliated by summer's end. Larvae cause further damage when they burrow into wood—including nearby siding on buildings—to pupate. The adult is a black wasp about 0.8 inch long with white markings and antennal tips.

Biology and life history Eggs hatch from the underside of the leaf and small larvae cluster together to begin feeding in July. Larger instars begin to defoliate trees in late summer, often in late August. Larvae pupate in rotting wood, house siding or soil in fall and emerge in late spring to lay eggs.

Pest monitoring Newly hatched larvae congregate in clusters in leaves at the tops of trees. From below, the clusters of larvae are visible as sunlight penetrates the thin leaves, revealing dark clumps.

Management—cultural control

Prune out infested branch tips at the tops of trees when larvae are noticed.

Management—biological control

It is likely that native predators and parasitoids will find this food source.

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

For more information

See "Sawfly" in:

Common Landscape Pests

Douglas-fir (*Pseudotsuga*)—Aphid

Giant conifer aphids (*Cinara* spp.)
Cinara pseudotsugae

Pest description, and damage These aphids infesting Douglas-fir are up to 0.2 inch in length. They range in color from gray to brownish to black. Aphids establish large colonies on the twigs, but rarely are found feeding on needles. Feeding produces a honeydew that promotes sooty mold on foliage and underlying surfaces. Yellowjackets and ants are found in tree canopy foraging for honeydew.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Douglas-fir (*Pseudotsuga*)—Brown soft scale

Coccus hesperidum

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Brown soft scales are yellowish to dark brown insects (adults are usually darker) that range in length from 0.1 to 0.2 inches. They are found mainly on twigs, although young scales also may be found on the foliage, typically on the underside of needles. Scale insects suck plant sap and produce copious honeydew on which sooty mold may grow.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Douglas-fir (*Pseudotsuga*)—Coneworm

Dioryctria spp.

Pest description and damage Adult coneworms are mottled gray or brown snout moths banded with subtle waves of color and about 0.6 to 0.7 inch in length. Coneworm larvae are small and cream-colored or light brown with a darker head. Coneworms attack true firs by boring into shoot tips or stems, especially around wounds, and feeding on the soft bark tissues. The portion of the branch beyond the injured point may die back. Coneworms also may bore into green cones, feed on the soft bark of young growth or on graft unions, or feed inside the bark on the trunk cambium. Coneworms also attack hemlock and spruce. Many species of *Dioryctria* feed on different parts of small plants, trunk, and shoots as well as cones. Confounding the issue are insects of other orders that attack cones and several other small moths that bore into shoots. This damage can be a serious problem in Douglas-fir grown for seed.

Management—cultural control

Plant resistant conifers where this pest is a problem. Remove and destroy infested cones and twigs when possible.

Management—biological control

Natural enemies of the coneworm are likely, but not listed.

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Douglas-fir (*Pseudotsuga*)—Cooley spruce gall adelgid

Adelges cooleyi

Pest description and damage This aphid-like insect feeds on new needle growth of Douglas-fir. Adelgids appear as woolly or cottony tufts on the undersides of needles; heavily infested trees appear to be flocked. Small (0.04 to 0.07 inch in length) purplish insects are found underneath the cottony tufts. Adelgid feeding can cause needles of Douglas-fir to become distorted or bent and yellow. Infested needles turn brown and sometimes drop prematurely. This pest is a serious concern in Christmas tree plantations but is less important in the landscape. Cooley spruce gall adelgids also infest spruces, but the distinctive galls on spruce do not occur on Douglas-fir.

Biology and life history The biology of this pest is complex with the insect alternating between Douglas-fir and spruce and cycling on the Douglas-fir.

Management—cultural control

Plant Douglas-fir and spruce as far apart as possible. Hand-wipe small infestations.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

See "Douglas-fir" in:
Christmas Tree Plantation Pests

Douglas-fir (*Pseudotsuga*)—Douglas-fir needle midge

Contarinia spp.

Pest description and damage The adult Douglas-fir needle midge is a tiny (around 0.05 inch in length) delicate-looking fly. Three different midges infest Douglas-fir: one species feeds near the needle base, one feeds near the tip of the needle, and the third feeds near the middle. The tiny white larvae of the Douglas-fir needle midge mine the inside of needles, which become yellowed and distorted. Infested needles often bend sharply at the injury site. Damaged needles often drop from the tree, and heavy midge infestations can cause severe defoliation. This pest is more significant in Christmas tree plantations and less of a problem in landscapes or wooded stands.

Biology and life history The midges pupate in the ground, with the adults emerging around budbreak in the spring. They lay eggs on the new growth, and the newly hatched larvae mine the needles and feed through the summer. At the end of the summer, they drop to the ground to pupate. There is one generation per year.

Management—cultural control

Prune out heavily infested twigs and branches.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Douglas-fir (*Pseudotsuga*)—Douglas-fir tussock moth

Orgyia pseudotsugata

Pest description and damage The adult male is brown to gray with a 1-inch wingspan that flies during the day in search of the wingless female moth. The larvae feed on pine needles and the mature larvae are about 1 inch in length, hairy, gray, or light brown, with black heads. The larvae have three long tufts of black hairs on their body (two in front, one in back) and shorter dorsal tufts along their back. The hairs from tussock moth caterpillars break off easily and may cause skin or respiratory irritation. The larvae start feeding at branch tips at the top of the tree and work down, feeding mainly on the new foliage and causing severe defoliation. The preferred hosts are Douglas-fir, grand fir, and white fir, although it also may be a problem on spruce, pine, true fir, and larch. They feed mainly on forest trees and are infrequent pests in the landscape.

Biology and life history The insect overwinters as egg masses deposited on or near the cocoons of the wingless female. The larvae emerge in the spring as buds break and begin feeding on the new growth. The insect pupates in cocoons on the host plant, and adults emerge in summer. Males seek out the flightless females that look like a grayish bag with legs. There is one generation per year.

Management—biological control

A variety of predators and parasitoids keep this pest under control most of the time. Severe tussock moth outbreaks are sporadic and tend to last about three years before subsiding.

Management—cultural control

Prune off and burn infested branches. Do not touch caterpillars with bare hands as some people are sensitive to their irritating hairs. Hand-pick

caterpillars preferably while wearing gloves. Avoid rubbing your eyes as hairs can penetrate the eyeball causing intense pain.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Douglas-fir (*Pseudotsuga*)—Douglas-fir twig weevil

Cylindrocopturus furnissi

Pest description and damage The Douglas-fir twig weevil is a small (about 0.1 inch in length), wingless, grayish-black beetle with white markings and sometimes pinkish spots. The larvae mine under the bark or inside twigs. Infested twigs and small branches often turn reddish-brown and die back. Small, stressed trees, and those in Christmas tree plantations, are especially susceptible to attack by weevils, particularly in dry years. There are several related species on pine and true fir.

Biology and life history The weevil overwinters as a larva or adult. Adults emerge from June through early August. They lay eggs in twigs during the summer. The larvae feed by mining just beneath the bark and pupate at the ends of the galleries the following spring. There is one complete generation per year and a partial second.

Pest monitoring Watch for wilting or reddish-brown twigs and branch tips of small branches.

Management—cultural control

Pick off adults if seen. Remove and burn infested twigs before adults emerge. Keep trees healthy with proper cultural practices, as healthy trees can better withstand insect damage.

Management—biological control

None indicated.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Douglas-fir" in:
Christmas Tree Plantation Pests

Douglas-fir (*Pseudotsuga*)—Pine needle scale

Includes
Pine needle scale (*Chionaspis pinifoliae*)
Black pine scale (*Dynaspidiotus* (*Nuculaspis*) *californica*)

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Pine needle scale insects are about 0.125 inch in diameter, elongate, white scales that are found on and feed on the needles. Heavily infested trees may appear crusted with white. Infested needles turn yellow, then brown. Twigs and branches are killed. Repeated infestations may kill trees eventually. Pine needle scales often are found with the about 0.06-inch long black pineleaf scales, which are gray to black instead of white. Pine needle scale is a serious pest of ornamental pines and may infest arborvitae, cedar, hemlock, and spruce.

For biology, life history, monitoring and management

See:
Pine (*Pinus*)—Pine needle scale

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Douglas-fir (*Pseudotsuga*)—Pitch moth

Douglas-fir pitch moth (*Synanthedon novaroensis*)
Sequoia pitch moth (*Synanthedon sequoiae*)

Pest description and damage These adults are clearwing moths about 1.0 to 1.25 inch in length with either yellow and black markings (sequoia) or

orange and black markings (Douglas-fir) resembling yellowjacket wasps. The mature larvae are over 1 inch long, yellowish, with a reddish-brown head (sequoia) or naked ivory-white with brown marks on the thorax (Douglas-fir). The larvae of the sequoia pitch moth feed by boring into branches or trunks. At the point where the larva enters the wood, small to large masses of creamy yellow to pinkish pitch accumulate. The larva feeds locally underneath the pitch mass. This pest causes mainly aesthetic damage because of the dripping pitch and pitch masses. These moths have a wide range of pine tree hosts, but the sequoia pitch moth does not attack sequoia (a.k.a. the coast redwood).

Biology and life history Eggs are laid on the bark of host trees. The larvae bore into the inner bark and establish a feeding site. The feeding site is distinguished by the large accumulation of pitch and frass on the exterior of the bark. Pupation takes place within this mass. When adults emerge, the pupae wriggle to the surface and protrude from the pitch mass. The adult moths fly in summer. About half the population completes its life cycle in one year; the other half requires two years.

Pest monitoring Pheromone traps are available to time adult activity and entrap males.

Management—cultural control

Healthy trees are rarely attacked. Infestations often are associated with pruning wounds or mechanical damage to the tree. Trees that are wounded in the spring and summer when adult moths are flying are far more likely to be attacked than those pruned or injured in the fall and winter. The moths are attracted to trees undergoing stresses associated with drought or saturated soil. Remove pitch masses and caterpillars by hand before pupal cases protrude.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Douglas-fir (*Pseudotsuga*)—Silver-spotted tiger moth

Lophocampa argentata

Pest description and damage Adult moths have a 2-inch wingspan and are brownish or tan with distinct silvery translucent spots on the wings. The caterpillars can reach 1.5 inches in length and are mostly reddish-brown with some blue-black or yellowish hairs. The caterpillars of the silver-spotted tiger moth feed on the needles, often "tenting" branches with dirty-looking webs. Feeding occurs through fall and winter, with webs becoming more noticeable by spring. Buds are not harmed and the new growth in spring usually covers most damage. Minor infestations cause little harm to landscape trees, though there have been reports of forest defoliation. Douglas-fir is the preferred host, but pine, arborvitae, spruce, and true fir also are attacked.

Biology and life history Clusters of round emerald green eggs are laid on needles at the tips of branches. In fall, tiny white larvae make a small tent of fine webbing at the tip of a branchlet. The larvae hibernate in dense clusters in these webs. They feed on host tree foliage on warm winter days. As the larvae mature, the damage and webs become more noticeable causing some concern among homeowners. In June, the mature larvae are found wandering on non-host plants, patios, and decks, in search of a good spot to spin their cocoon. Cocoons consist of the reddish-brown caterpillar hairs interwoven in the silk of the cocoon.

Management—biological control

This insect is controlled in landscape settings by parasitoid wasp (*Ophion* spp.) and flies (Tachinids) that cause the moth population to crash. *Tachinomyia similis* (Williston) is a large fly that also parasitizes this insect.

Management—cultural control

Prune out and destroy tents with caterpillars. Caterpillar hairs can cause skin irritation in some people if they are handled without gloves. Do not rub eyes or hairs can become painfully embedded in the eye tissue.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Douglas-fir (*Pseudotsuga*)—Spruce spider mite

Oligonychus ununguis

Pest description and damage Several species of spider mites can cause damage in coniferous ornamentals. The appearance of these mites varies with the species, although all are 0.02 inch or smaller. The spruce spider mite is dark green to nearly black with salmon-pink legs. The spherical eggs are laid at the base of needles and hatch in April and May. They can complete a generation in 17 days and build up particularly high populations during hot, dry weather. Sometimes plants are covered with fine silk webbing at branch axils or over sections under very heavy infestations. Mites damage leaves by sucking cell contents, which causes stippling, bronzing, and possibly needle drop. The reduction in photosynthesis causes loss of vigor and yield. Trees under continuous attack may look dingy brown or die from the bottom up.

For biology, life history, scouting, and management options

See "Spider mite" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Elderberry (*Sambucus*)—Borer

Elderberry borer (*Desmocerus aureipennis*)

Pest description and damage The immature roundheaded borer that matures to a 1.0 to 1.25 inch long reddish cerambycid beetle with a black thorax and head is found on elderberry in Washington and is associated with round exit holes surrounded by shattered bark of the stems of this shrub. With the increase of ornamental elderberry cultivars, there are more reports of wilting canes and even death of shrubs. Canes start to wilt at the tips with damage continuing down the canes. Infested canes are lumpy and round exit holes with shattered bark are visible.

Biology and life history Little is known of this beetle. Both the borers and adult beetles are found associated with elderberry in the Cascade Mountains and along Puget Sound and Willapa Bay in Washington. One observant horticulturist said that damage begins with wilting tips, suggesting eggs are laid at the tips of canes and as the larva burrows downward, the cane wilts further.

Pest monitoring Watch for the first signs of wilted tips in spring. Cut well below the wilted area and inspect for the larva by splitting the cane.

Management—cultural control

To control larvae boring through the cane, remove the cane just below the wilted portion when symptoms are noticed.

Management—biological control

None known.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

For more information

See "Wood borers" in:
Common Landscape Pests

Elderberry (*Sambucus*)—Leafcutting bee

Megachile spp.

Description and crop damage Leafcutting bee activity is noted by the uniform oval and round pieces cut from the edges of leaves. The adult bee is about 0.4 inch in length, black with white stripes, and uses these little oval plant pieces to line the sides of an old beetle gallery or hole in the ground. She then gathers pollen to form a ball of food, and lays one egg, then seals the apartment with a wall made of a round leaf piece. Damage is transitory on young leaf tissues only. Once leaves have hardened off, the leaf cutters will find other suitable hosts.

Management—cultural control

If the missing leaf portions are objectionable, try laying a light sheet or fine curtain netting over the plant until the leaves have hardened off, or the bees have found another suitable leaf donor. The trade-off between pollination services provided by the leafcutting bees and the damage can be a beneficial one. Elderberry plants are rarely harmed by the loss of these round leaf tissues.

Elm (*Ulmus*)—Aphid

Woolly apple aphid (*Eriosoma lanigerum*)
Woolly elm aphid (*Eriosoma americanum*)

Pest description and damage Several species of aphids can become problems as foliar, twig or stem, or root feeding pests on elms. Some of the aphids have a summer alternate host where they infest roots, stems, lower trunk or leaves of *Amelanchier*, hawthorn, apple, pear, currant, or other rosaceous plants. Some aphids form galls on elm while others distort tissue or cause leaves to pucker and roll tightly. Woolly elm aphids are tiny (about 0.08 inch in length) and dusted with a light gray wax. They cause leaves to roll under from the edge of the leaf toward the midrib. Their alternate summer host is serviceberry. Woolly apple aphids form clusters on galls on elm. On apple trees, they produce long, white, waxy filaments and form noticeable white patches on bark, water sprouts and the roots. They also form lumpy galls on *Malus* branches and roots; heavy root galling can kill small trees. Feeding damage on elm leaves is aesthetically displeasing, but usually does not cause significant tree damage. If abundant on elm, they produce galled and distorted leaves and honeydew and can compromise the vigor of small trees.

Biology and life history The *Eriosoma* species all winter over on elm, in bark crevices. In spring, they produce young which feed on the elm leaves, then become mature winged adults, which migrate to their alternate hosts. They spend summer on these alternate hosts until fall when winged adults

are produced and migrate back to elm. Woolly apple aphid has adapted to overwinter on apple trees even in the absence of elms.

Pest monitoring Woolly elm bark aphids are best observed on bark before budbreak. Observe trees as they leaf out in spring to determine infestation levels, so that if pesticides are needed, they can be applied before damage is significant. Once leaves are distorted, the damage cannot be undone.

Management—cultural control

The woolly apple aphid prefers to infest wounds, callus tissue or other damaged areas on trees. Keep trees in good health and watered during periods of drought.

Management—biological control

Woolly aphids are regulated by predators and parasitoids. Syrphid fly larvae, lacewing larvae, and lady beetles are common predators on the aphids. Often by the time the aphids are noticed, predators are already on site and feeding. The wasp parasitoid *Aphelinus mali* also is reported to control woolly apple aphid.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

See "Aphid" in:
Common Landscape Pests

Elm (*Ulmus*)—Bark beetle

Includes
Elm bark beetle (*Hylurgopinus rufipes*)
Scolytus spp.

Pest description and damage Elm bark beetles are about 0.13 inch in length and shiny brown or black. The larvae are white, legless, and about 0.16 inch in length. Larvae and adults of both these species bore into the cambial and vascular tissues of trees, weakening them and causing wilting and dieback of individual stems and branches. Trunks and branches can be riddled with galleries. Beetles emerging from trees infected with Dutch elm disease infect the trees they attack next. Borers are primarily a problem on injured or stressed plants, but healthy trees growing adjacent to blocks of neglected trees are attacked.

For biology, life history, monitoring and management

See "Bark Beetle" in:
Common Landscape Pests

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Elm (*Ulmus*)—Carpenterworm

Prionoxystus robiniae

Pest description and damage Carpenterworms are the larvae of a large, mottled gray and black moth whose size ranges from 1.75 to 3.0 inches in length. The caterpillars are white to pinkish red with a dark head and are 1 to 3 inches in length when mature. The caterpillars bore in the trunk and main branches. Discolored or bleeding limbs, branch dieback, and lumpy or gnarled trunks may be indications of carpenterworm infestation. Typical symptoms of elm infestation are sawdust-like material (frass) and wood chips mixed with loose webbing on or around infested trees. Trees with severe carpenterworm infestations are susceptible to wind breakage and need to be removed to reduce risk. Eventually, carpenterworm infestations may kill host trees.

For biology, life history, monitoring and management

See:
Cottonwood (*Populus*)—Carpenterworm

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Elm (*Ulmus*)—Elm leaf beetle

Xanthogaleruca luteola

Pest description and damage Adult elm leaf beetles are approximately 0.25 inch in length and yellow to greenish with two dark stripes. Older

adults are darker. The 0.25-inch larvae are greenish or yellowish with black lateral stripes and spots. Elm leaf beetles feed on the leaves both as larvae and as adults. As larvae, they skeletonize leaves, feeding on the underside and eating all parts except the veins and upper cuticle, which then turn brown. Adult feeding causes small holes in the leaves. Severe infestations may result in severe premature leaf loss. Trees may leaf out again in late summer. Weakened trees are also more susceptible to attack by elm bark beetles, which can carry the Dutch elm disease fungus.

Biology and life history The insect overwinters as adults in protected places both indoors (often invading houses) and outdoors. In spring, the adults fly to trees as the leaves are expanding and chew circular holes in them. Clusters of pointed yellow eggs are laid on the leaves, and the larvae hatch in late spring (typically May–June) and begin skeletonizing leaves. They feed for a period, then migrate to the lower parts of the tree, and pupate on the ground or in crevices near the base of the tree. The second generation emerges one to two weeks later. There are two generations per year.

Pest monitoring Watch for emerging adults in spring then watch for small circular holes or skeletonizing of the tender new leaves as larvae feed. Best control is achieved when larvae are small and before damage is severe.

Management—cultural control

Plant resistant cultivars of American elm (*Ulmus americana*). These include 'Dynasty,' 'Princeton,' 'Prospector,' 'Frontier,' and 'Pathfinder.' (Note: Many American elm cultivars are highly susceptible to Dutch elm disease). Other elms reported to be somewhat resistant to elm leaf beetle feeding include Chinese elm (*U. parvifolia*) and the elm-like zelkovas (*Zelkova* spp.). Provide proper culture to maintain plant health. Healthy plants are more tolerant of insect damage. Prune dead and dying branches in late fall or winter. A shopvac or mower with catch bag may be able to remove larvae that drop to the ground to pupate.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Elm (*Ulmus*)—Elm leafminer

Fenusa ulmi

Description and crop damage Adults are tiny (about 0.16 inch in length), black, fly-like sawflies which can be seen on new foliage on sunny days. Small, legless leafminer larva feed between the layers of leaf epidermis, resulting in large brown blotches that gradually coalesce into one large mine consuming the entire leaf. Large trees may be completely defoliated; however, as new growth continues in May, the trees begin to leaf out at the branch tips and replace lost leaves with little apparent effect. On Camperdown elm, however, the mines do not coalesce, and the dark blotches are visible on the leaves that remain on the tree.

Biology and life history These sawflies overwinter as pupae in the soil. As trees begin to leaf out, adults emerge from the soil and are seen as black specks on the leaves. They begin to lay eggs, at first, in the angles where the secondary vein meets the midrib. As the larvae feed and grow, the mines appear to coalesce. Mature larvae drop to the soil to pupate. There is only one generation per year.

Pest monitoring Look for the small black adults as leaves unfold in the spring. They are most active when it is sunny within the tree canopy. The little black adults are easily visible on the upper leaf surface. Sticky cards placed on the sunny side of the plant in early April to provide early warning that monitoring should begin. Degree-day models are available.

Management—cultural control

As leaves drop, larvae are found on the soil and underlying pavement. Use of a shredding leaf blower in reverse, may remove a number of larvae, and dispatch them while making useful mulch.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more information

See "Leafminer" in:
Common Landscape Pests

Elm (*Ulmus*)—European elm scale

Gossyparia spuria

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The European elm scale insect is a reddish-brown to purplish scale surrounded by a conspicuous fringe of white, waxy material. They sometimes resemble mealybugs. The mature females are about 0.4 inch in diameter. The crawlers emerge in late spring and summer and are yellowish to dark brown. This scale feeds on twigs and branches as well as leaves. Feeding scales produce honeydew, a sweet, sticky material that attracts honeydew-feeding ants and honeydew and becomes covered with a growth of black sooty mold. Infested trees may show yellowing leaves and early leaf drop, followed by death of twigs and branches. Severe infestations may cause extensive damage.

Biology and life history These scales overwinter as immature crawlers in bark crevices of small branches and branch axils. In spring, the females lay eggs and by June, the crawlers are active. They move to the undersides of leaves to feed, remaining there all summer. Often, the scales drop to the

ground with the normal leaf-fall and die. There is one generation per year.

Management—cultural control

Asiatic elms such as Chinese elm (*Ulmus parvifolia*) are not infested. Siberian elm (*U. pumila*) is also resistant but is a poor shade tree. Provide proper culture to maintain plant health. Healthy trees are more able to tolerate scale infestations. Prune and destroy twigs to help control isolated infestations, when practical. Apply adhesive tape, double-sided or sticky side out, near infestations of adult scales to catch the crawler stage. As with aphids, avoid excessive nitrogen fertilizer, as this favors population increase.

Management—biological control

Natural enemies such as lady beetles, green lacewings and wasp parasitoids help control scale populations.

Management—chemical control

Avoid use of broad-spectrum insecticides that kill beneficial insects.

Dormant-season spray—Apply with enough water to cover the entire tree thoroughly.

Growing-season spray—Apply to control the immature crawler stage, usually in late spring to early summer. Scout for crawlers and gather life history data.

See Table 1 in:
Chemical Control of Landscape Pests

For more information

See "Scale insect" in
Common Landscape Pests

Elm (*Ulmus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inches in length, covered with yellow, rusty then black colored silky hairs. Adult moths have a 1-inch wingspan and are bright white with orange and black markings on the underside of their abdomens. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:
Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Elm (*Ulmus*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature oystershell scale is approximately 0.125 inch in length beneath a brown, or gray scale that is usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs of many broad-leaved deciduous plants. They occur less frequently on the leaves and other plant parts including fruit and seed pods. Scale infestations often are limited initially to isolated colonies on single branches or twigs.

For biology, life history, monitoring and management

See:
Ash (*Fraxinus*)—Oystershell Scale

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Elm (*Ulmus*)—Spiny elm caterpillar (mourning cloak butterfly)

Nymphalis antiopa

Pest description and damage The spiny elm caterpillar is the larval stage of the mourning cloak butterfly. The adult butterfly is approximately 2.5 inches across, with purplish brown to black wings bordered by a creamy yellow stripe and a row of blue spots. The larvae are purplish black with white specks and have a row of orange to red spots along the back and when mature approach 2.0 inches long. They have brownish prolegs and are clothed with long, forked spines. The caterpillars often feed in large groups and eat all the leaves on a branch before moving. Their feeding results in raggedly chewed leaves. Spiny elm caterpillars also feed on willow and poplar trees. This caterpillar is rarely considered a pest.

Biology and life history The adult butterfly overwinters in protected places and is found flying on warm spring days coinciding with budbreak. The females lay eggs in masses on twigs, and the larvae hatch and feed in large groups. After feeding, the mature larva pupates by suspending itself in a chrysalis from a leaf. The second generation, if there is one, emerges in August.

Management—biological control

There are several wasp parasites of the larvae. Birds will pursue and eat the adult butterfly.

Management—cultural control

Hand-pick larvae or remove heavily infested branches.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Euonymus (*Euonymus*)—Cottony camellia scale

Pulvinaria floccifera

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The most visible stage of the cottony camellia scale insect is the adult female that resembles a flat 0.125-inch diameter scale often found on the underside of a leaf. Emerging from beneath the adult female is an oblong cottony white egg mass that can be up to twice the length of the scale. The cottony camellia scale (sometimes called taxus scale) crawlers are flat brownish or yellowish sucking insects. Foliage with scale infestations may turn yellowish or pale in color. Due to copious honeydew, leaves below are covered with a crust of black sooty mold. It is possible to have low numbers of this insect for years without an outbreak.

For biology, life history, monitoring and management

See:
Camellia (*Camellia*)—Cottony camellia scale

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Euonymus (*Euonymus*)—Euonymus scale

Unaspis euonymi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The female Euonymus scale insects are dark, 0.063 inch in length, and are under mussel shaped scales. The males are under narrow, elongated, and white scales. Crawlers are orange. Euonymus scales are found on both leaves and stems. Infested leaves develop yellow to white spots from scale feeding, and in severe cases significant defoliation can occur. Euonymus scale infests a wide range of ornamental genera that include *Camellia, Buxus, Daphne, Hedera, Ilex, Jasminum, Ligustrum, Lonicera, Pachysandra,* and *Prunus*.

Biology and life history The scales overwinter as fertilized females. In the spring, these females lay eggs and the crawlers emerge from beneath the shells to begin feeding. There may be two to three generations per year.

Management—cultural control

Evergreen euonymus (*E. japonica*) is extremely susceptible to scale infestations, as is spindle tree (*E. europaeus*). *Euonymus alata* (especially 'Compacta') and *E. fortunei* 'Acutus' are seldom infested. Several other species, including *E. kiautschovicus*, will tolerate scale feeding. Hand-wipe to help control small infestations, when practical. Prune out heavily infested branches. Apply double-sided tape around or near infestations of adult scales to catch the crawler stage. As with aphid, avoid excessive nitrogen fertilizer as this favors population increase.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

See "Scale insect" in:
Common Landscape Pests

Euonymus (*Euonymus*)—Root weevil

Numerous species

Pest description and damage Identification is important as different species differ in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles, from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Euphorbia (Euphorbia)—Aphid

Potato aphid (*Macrosiphum euphorbiae*) and others

Pest description and damage Clusters of slate gray aphids can congregate in prodigious numbers along stems and under flowers of *Euphorbia*. Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Aphids may vary in color depending on species from greenish to dark grey.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Fir (*Abies*)—Balsam twig aphid

Mindarus abietinus

Pest description and damage Balsam twig aphids feed on needles and buds of firs. Three distinct forms of the balsam twig aphid occur. Aphids may be (1) small (0.06 to 0.07 inch in length) and yellow green, (2) large and bluish-gray, or (3) have woolly white secretions that make them appear powdery. The aphids mat needles together as though coated with sugar and cause new growth to be deformed and stunted. Some needles are killed and drop from the tree, leaving rough twigs.

Biology and life history Unlike other aphid species, there is only one generation per year. The aphid overwinters as eggs on host trees. The eggs hatch and the nymphs molt into "stem mothers," which are large and blue-gray, and capable of giving birth to live young. These aphids are covered with a white waxy coating. They feed on new flushes of growth, doing most of the damage. They mature into the final, winged form, the females of which lay the overwintering eggs in bark crevices.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Fir (*Abies*)—Balsam woolly adelgid

Adelges piceae

Pest description and damage The balsam woolly adelgid is about 0.04 inch in length, feeds on the stems of true firs. White or grayish cottonlike masses of eggs or newly hatched purplish-black insects are found on the twigs, branches, or trunk. Heavy adelgid infestations may cover the entire trunk. The feeding insects cause the tree to form swollen, knoblike areas at nodes and tips of infested branches. Adelgid infestations weaken trees, cause foliage to become sparse, and can kill trees. This is a serious pest in the forest and common to the landscape on balsam, grand, subalpine, Pacific silver, and Fraser firs. Balsam fir and subalpine fir are particularly susceptible.

Biology and life history The entire population consists of female insects, which are wingless. They are immobile except for a crawler stage. Crawlers are carried from tree to tree by wind. Eggs are laid on the bark, from which the crawlers emerge. There are two to four generations per year.

Management—biological control

Examine adelgid colonies for small lady beetles or their wax-covered black larvae. Syrphid fly larvae also help control adelgid populations. Avoid use of broad-spectrum insecticides that will kill these important predators.

Management—cultural control

Hand-wipe or use stiff brush to remove minor infestations on smaller trees when possible. Hose infested trees with a strong stream of water to wash off these insects.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Fir (*Abies*)—Giant conifer aphid

Bow-legged fir aphid (*Cinara curvipes*)
Giant conifer aphid (*Cinara* spp.)

Pest description and damage This large (0.13 to 0.2 inch in length), brownish-black aphid congregates in large colonies on branches (especially the undersides). Aphids dropping onto underlying foliage or decks look somewhat like spiders. They secrete honeydew and promote sooty mold and their feeding can cause needles to turn yellow and drop prematurely resulting in defoliated branches. The aphids also produce copious honeydew, which attracts yellowjackets and other wasps. Black sooty mold may also develop on the honeydew, blocking light to the needles.

Biology and life history Eggs overwinter on needles and bark in the trees. The large black stem mothers hatch in early spring and give birth to young aphid nymphs that grow and soon begin giving birth to more aphids. Each stem mother produces live young that cluster in conspicuous aggregations of aphids among needles or on the undersides of larger branches. There may be multiple generations through the summer months.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Fir (*Abies*)—Coneworm

Dioryctria spp.

Pest description and damage Adult coneworms are mottled gray or brown snout moths banded with subtle waves of color and about 0.6 to 0.7 inch in length. The coneworm larvae are small and cream-colored or light brown with a darker head. Coneworms attack true firs by boring into shoot tips or stems, especially around wounds, and feeding on the soft bark tissues. The portion of the branch beyond the injured point may die back. Coneworms also may bore into green cones, feed on the soft bark of young growth, or feed inside the bark on the trunk cambium. There are many species of *Dioryctria* that feed on different parts of small plants, trunk and shoots as well as cones. Confounding the issue are insects of other orders that attack cones and several other small moths that bore into shoots.

For biology, life history, monitoring and management

See:
Douglas-fir (*Pseudotsuga*)—Coneworm

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Fir (*Abies*)—Spruce budworm (Western)

Choristoneura occidentalis

Pest description and damage Adult moths are mottled orange-brown and have a wingspan up to 1 inch. The larvae are typically green to brown with a darker head and white tubercles in later stages. Mature larvae grow to approximately 1 inch in length. These larvae feed on buds and foliage and may tie shoot tips together with webbing to make a nest. Spruce budworms are mainly pests of balsam and subalpine firs. They also attack spruce and Douglas-fir adjacent to infested fir trees. Although a significant problem in forestry situations, this insect is an infrequent pest in the landscape.

Biology and life history The larvae overwinter in small silken cocoons which are hard to locate. The following spring, larvae emerge and spin long silken threads that aid in their dispersal. Eggs are light green and laid in shingle-like masses on the underside of needles in mid-July. A needle with a layer of green eggs looks thicker than others.

Management—cultural control

Hand-pick and destroy larvae when found.

Management—biological control

Budworm populations are regulated by several natural factors such as insect parasitoids, vertebrate and invertebrate predators, and adverse weather conditions.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Fir (*Abies*)—Spruce spider mite

Oligonychus ununguis

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen and coniferous ornamentals. The appearance of these mites varies with the species, although all are 0.02 inch or smaller. The spruce spider mite is dark green-to nearly black with salmon-pink legs. The spherical eggs are laid at the base of needles and hatch in April and May. They can complete a generation in 17 days and build up particularly high populations during hot, dry weather. Plants are covered with fine silk webbing at branch axils or over sections under very heavy infestations. Mites damage leaves by sucking cell contents, which causes stippling, bronzing, and possibly needle drop. The reduction in photosynthesis causes loss of vigor and yield. Trees under continuous attack may look dingy brown or die from the bottom up.

For biology, life history, monitoring and management

See "Spider mite" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Firethorn (*Pyracantha*)—Azalea and rhododendron lace bug

Azalea lace bug (*Stephanitis pyrioides*)
Rhododendron lace bug (*Stephanitis rhododendri*)

Pest description and damage These insects use piercing–sucking mouthparts to feed on individual cells, so the upper leaf surface is yellow and stippled. The underside of leaves is covered with black tar-like spots. Infestations are more severe on plants in the sun. Damage is usually apparent around early to mid-July. While almost never fatal, repeated infestations of rhododendron lace bugs may result in yellowed, sickly plants. Adult insects are whitish-tan and approximately 0.13 inch in length with lacy-looking wings. Nymphs grow to about 0.13 inch in length and are spiny. The damage the insects cause is similar on first inspection to that of leafhoppers, but with tar-spots. Identification is based on the dark markings on the thorax and forewings.

For biology, life history, monitoring and management

See:
Azalea (*Rhododendron*)—Azalea and rhododendron lace bug

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Firethorn (*Pyracantha*)—Cherry bark tortrix

Enarmonia formosana

Pest description and damage Cherry bark tortrix is a pest of most woody ornamental trees and shrubs in the family Rosaceae. The larvae are 0.33 to 0.4 inch in length, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a yellowish-brown head. Larvae feed directly on the cambium under the tree bark and may cause death of the tree in sufficient numbers. Otherwise, the feeding activity decreases the supply of nutrients to the tree and increases susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the exuding of reddish-brown gum-like resin, mixed with fecal pellets and silk. The trunk and larger limbs of plants are affected, usually at pruning wounds on larger limbs or around graft unions. The adult moth has a wingspan of about 0.33 inch and is a mottled yellow, cream and brown in appearance.

For biology, life history, monitoring and management

See:

Cherry (*Malus*)—Cherry bark tortrix

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Firethorn (*Pyracantha*)—Root weevil

Many species

Pest description and damage Species identification is important as root weevil species differ in susceptibility to pesticides and have different life cycles. Adult weevils are dark colored beetles from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Tips may die beyond the point where weevils have girdled the twig (salal, firethorn, rockrose, yew, juniper, etc.).

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Forsythia (*Forsythia*)—Root weevil

Lilac root weevil (*Otiorhynchus meridionalis*) and numerous other species

Pest description and damage Identification is important as root weevil species differ in susceptibility to pesticides and may have different life cycles. Adult weevils are dark colored and nocturnal, from 0.2 to 0.25 inch in length. East of the Cascades, the lilac weevil is especially common. Look for regular U-shaped notches along the leaf edges. This is species is unusual because males are common, and adults are often found in tandem. These nocturnal adults are nearly black and shiny with a snout (rostrum) and elbowed antennae. Larval feeding on roots is rarely a problem in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Fuchsia (*Fuchsia*)—Aphid

Includes potato aphid (*Macrosiphum euphorbiae*)

Pest description and damage Several species of aphid may infest fuchsia. The aphids feed initially on the shoot tips, which can cause stunting and malformation of the tips. The feeding and honeydew production can cause sooty mold problems. Aphids tend to be small (.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies, but most aphids tend to match host plant coloration. Aphids tend to feed in colonies and are found on the most succulent plant tissues. When aphid populations are high, damage can be severe. Aphids produce honeydew, a sweet, sticky secretion that collects on underlying plant tissues and encourages growth of a black sooty mold. In addition to cosmetics, honeydew may become a sticky nuisance when it falls on decks, cars, or other landscape surfaces.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Fuchsia (*Fuchsia*)—Cyclamen mite

Steneotarsonemus (*Phytonemus*) *pallidus*

Pest description and damage The cyclamen mite is extremely tiny and only visible with high magnification. When mature, it measures only about 0.01 inch. Mature mites are pinkish-orange and shiny. The hind legs are threadlike in the female and grasping or pincerlike in the male. At low population densities, cyclamen mites are found along the midvein of young, unfolded leaves and under the calyx of newly emerged flower buds. At high population densities, these mites can be found anywhere on nonexpanded plant tissue. The mites infest growing tips, young leaves, and blooms and cause distorted, twisted, and blistered growth. They are spread by wind and by the movement of infested stock.

Biology and life history Cyclamen mites overwinter as adult females. Eggs are translucent and comparatively large. Adult females lay about 90 eggs, 80% of which develop into females. During summer, newly hatched mites develop into mature adults within two weeks. Populations build rapidly soon after they begin to infest a planting.

Pest monitoring Look for tightly curled and distorted leaves.

Management—biological control

Predatory mites are important biological control agents of these mites.

Management—cultural control

Avoid planting, or propagating from, infested plants. Eliminating cyclamen mites from infested plants is very difficult. Cyclamen and broad mites are sensitive to heat and thus thrive in the cooler temperatures of early spring and fall (winter in the greenhouse). Hot water dips (100°F for 30 minutes; or 111°F for 15 minutes) are used to control cyclamen mites. This can be done prior to planting, or to disinfest cuttings prior to propagation to clean new stock.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Fuchsia (*Fuchsia*)—Fuchsia gall mite

Aculops fuchsiae

Pest description and damage Tiny (about 0.01 inch in length), elongated, eriophyid mites infest the growing tips, young leaves, and blooms and cause distorted, twisted, and blistered growth. They are primarily a problem in coastal areas. They are spread by wind, pollinating insects, and birds, and by movement of infested stock.

Biology and life cycle This eriophyid mite develops in the unopened leaves and buds. Then, they leave those tissues and move outward as new leaves and buds are forming.

Pest monitoring Look for the gall symptoms and distortions on leaves and buds. When possible, confirm mite presence with hand lens.

Management—biological controls

Predatory mites are important biological control agents of these mites.

Management—cultural control

Fuchsia species and cultivars differ widely in susceptibility to these mites. Some control is gained by removing infested plant parts. It is extremely easy to spread these mites to other plants after handling infested plants; thorough handwashing is advised. Mites are carried on clothing.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more information

See "Gallmakers" in:
Common Landscape Pests

Bergquist, R. 2004. Food for Thought Regarding Fuchsia Gall Mites. American Fuchsia Society (http://www.americanfuchsiasociety.org/fuchsiaarticles/fuchsiagallmite4-2004.html)

Anon. Susceptibility of Fuchsia Species or Cultivars to Fuchsia Gall Mite Damage in California. UC-IPM

(http://www.ipm.ucdavis.edu/PMG/GARDEN/PLANTS/INVERT/vrfuchsiagall.html)

Fuchsia (*Fuchsia*)—Root weevil

Numerous species

Pest description and damage Species identification is important as root weevil species differ in susceptibility to pesticides and have different life cycles. Adult weevils are dark colored beetles from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Damage by C-shaped larvae may cause plants to wilt and die. Larval damage is noticed in containers where successive generations of weevils and limited room for a healthy root system favors damage.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Fuchsia (*Fuchsia*)—Whitefly

Numerous species of *Aleyrodidae*

Pest description and damage Whiteflies are tiny (0.04 to 0.08 inch in length), pure white, moth-like plant sucking insects. They lay tiny black eggs inserted on the undersides of leaves. The nymphs are yellowish and feed by sucking plant sap from the host. Leaves may turn yellow or dry and drop. Lower leaves may be covered by honeydew followed by the sooty mold fungus. Some whiteflies can transmit viruses. Fuchsias are damaged severely by high populations of whiteflies.

For biology, life history, monitoring and management

See "Whitefly" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Geranium (*Pelargonium*)—Aphid

Geranium aphid (*Acyrthosiphon malvae*)
Green peach aphid (*Myzus persicae*)

Pest description and damage Several species of aphids may feed on the foliar, stem, flower, bud, bark, or root tissues of geraniums. Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies (black, green, pink, yellow, mottled, striped, etc.), but most aphids tend to match host plant coloration. Aphids tend to feed in colonies and are found on the new or most succulent plant tissues. Feeding damage to mature plants is usually minor, but can compromise the vigor of the host. When aphid populations are high, leaf and shoot distortion can occur. Aphids produce honeydew, a sweet, sticky secretion that collects on underlying plant tissues and encourages growth of a black sooty mold. In addition to cosmetics, honeydew may become a sticky nuisance when it falls on decks, or landscape surfaces. Some aphids are vectors of plant diseases, particularly viruses.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Geranium (*Pelargonium*)—Leafroller

Numerous species including:
Oblique-banded leafroller (*Christoneura rosaceana*)
Orange tortrix (*Argyrotaenia franciscana*)

Pest description and damage The larvae of the orange tortrix are light cream to green with light brown heads and are up to 0.5 inch long at maturity. Oblique-banded larvae are similar in size but are darker green with dark brown to black heads. Both roll leaves and tie them with silk.

For biology, life history, monitoring and management

See:

Cherry, flowering (*Prunus)*—Oblique-banded leafroller

See "Leafroller" in:

Common Landscape Pests

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Gladiolus (*Gladiolus*)—Thrips

Gladiolus thrips (*Thrips* [*Taeniothrips*] *simplex*)

Pest description and damage Adult thrips emerge milky-white but soon turn brown and begin feeding. The female is approximately 0.06 inch in length and slightly larger than the male. The egg is about 0.0125 inch long, opaque white, smooth, and bean-shaped. Eggs are deposited in the leaf tissue and corms. Thrips feed by rasping the surface of the leaves or corms, which causes plant juices to flow. The affected leaf surfaces turn a whitish-gray and eventually dry out and turn brown. Infested flowers are discolored, spotted, and entire spikes may fail to bloom. Affected corms are discolored and deformed and are prone to decay. Plants do not develop normally from such corms.

Biology and life history These thrips are native to Africa and cannot overwinter outdoors where temperatures consistently drop below 50°F. The thrips are brought into previously uninfested gardens or greenhouses on infested corms. These thrips can overwinter at any stage on stored corms or on plants growing in greenhouses. The life cycle consists of six stages: the egg, two larval instars, two pupal instars and the adult stage. Females deposit 100 to 200 eggs. During the warm growing season, the development of the gladiolus thrips can occur in about two weeks. With such rapid development, the thrips can have nine or more generations outside during the growing season. The eggs are deposited in the leaves of gladioli or in the corms in storage. Larvae and pupae can be found in the buds or leaf sheaths, although the larvae often drop to the ground to transform into the quiescent pupae. Adult gladiolus thrips live 35 to 40 days.

Pest monitoring Observe growth for spotting or bleaching of foliage, or for plants that fail to grow vigorously. Bloom stalks may shrivel as though dry.

Management—biological control

Some control of thrips by predatory mites is possible. *Stratiolaelaps scimitus* (formerly known as *Hypoaspis miles*) and *Neoseiulus* (*Amblyseiulus*) *cucumeris* are both considered effective predators of mites and possibly thrips and are commercially available.

Management—cultural control

Storing corms at cool temperatures will eliminate all life stages of the thrips from the corms. After cold storage for a minimum period of six weeks at 35.6°F or 8 weeks at 41°F, larvae, pupae, and adult specimens died and eggs were no longer viable. Storage of corms at these low temperatures, provided they were well dried, proved not to be harmful to emergence and growth. Prompt removal of infested plants and corms once symptoms are noted helps arrest spread within a planting to uninfested plants.

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

For more information

See "Thrips" in:

Common Landscape Pests

Golden chain (*Laburnum*)—Aphid

Includes laburnum aphid (*Aphis cytisorum*) and other species

Pest description and damage Several species of aphids may infest Laburnum. Initially, these aphids feed on the shoot tips, which on young trees can cause stunting and malformation of the tips. They also infest the seed pods making them unsightly with honeydew, sooty mold, and aphid exoskeletons. Aphids tend to be small (.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies but most aphids tend to match host plant coloration. Laburnum aphid is a dark green aphid. Aphids tend to feed in colonies and are found on the new or most succulent plant tissues. When aphid populations are high, leaf and shoot distortion can occur. Aphids produce honeydew, a sweet, sticky secretion that collects on underlying plant tissues and encourages growth of a black sooty mold. In addition to cosmetics, honeydew may become a sticky nuisance when it falls on decks, cars, or other landscape surfaces. Some aphids are vectors of plant diseases, particularly viruses.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Golden chain (*Laburnum*)—Laburnum Leafminer

Leucoptera laburnella

Pest description and damage This leafminer forms blotch mines in leaves and can defoliate trees. Adult moths are roughly 0.1 inch in length, slender with white wings with a small black spot at the rear end. The larva is white with parallel, undulating segments. The leafmine begins as brown spot, then a slender winding mine forms that suddenly widens to forms a blotch mine with swirls of green or black frass. Larvae leave the mine, weave parallel strands of silk across the leaf, then pupate suspended among the silk.

Management—chemical control

See "Leafminer" in:

Common Landscape Pests

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Golden chain (*Laburnum*)—Spider mite

Tetranychus spp.

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen, and coniferous ornamentals. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Other spider mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants are covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites damage leaves and fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Hawthorn (*Crataegus*)—Apple-and-thorn skeletonizer

Choreutis pariana

Pest description and damage Adult moth is reddish brown, with a wingspread less than 0.5 inch, and irregular light and dark bands on the wings. Larvae are 0.5 inch in length, yellowish to greenish, with black spots and a yellow-brown head. Pupae are yellow to brown with a white silken cocoon. The larvae skeletonize and roll leaves from the sides. Damaged leaves are brown and papery and drop prematurely. Damage varies from inconsequential to serious, so monitoring is an important management tool. Damage is rarely lethal to the tree.

For biology, life history, monitoring and management

See:

Crabapple (*Malus*)—Apple-and-thorn skeletonizer

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Hawthorn (*Crataegus*)—Azalea bark scale

Eriococcus azaleae

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The immature azalea bark scale insects superficially resemble mealybugs in appearance. Mature female scales are about 0.13 inch in

length and appear like white cottony sacs, often located on twigs and stems of azalea, especially in branch axils. Eggs, crawlers, and adults under the whitish cotton are red.

For biology, life history, monitoring and management

See:

Azalea (*Rhododendron*)—Azalea bark scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Hawthorn (*Crataegus*)—Cherry bark tortrix

Enarmonia formosana

Pest description and damage Cherry bark tortrix is a moth pest of most woody ornamental trees and shrubs in the family Rosaceae. The larvae are 0.33 to 0.4 inch in length, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a yellowish-brown head. Larvae feed directly on the cambium under the tree bark and may cause death of the tree over time. Otherwise, the feeding activity decreases the supply of nutrients to the tree and increases susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the exuding of a reddish-brown, gum-like resin, mixed with fecal pellets and silk. The trunk and larger limbs of bearing fruit trees are affected, usually at pruning wounds and graft unions. The adult moth has a wingspan of about 0.33 inch and is a mottled yellow, cream and brown in appearance.

For biology, life history, monitoring and management

See:

Cherry (*Malus*)—Cherry bark tortrix

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Hawthorn (*Crataegus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature the caterpillars are over 1.25 inch in length, covered with yellow, rusty then black colored silky hairs. Adult moths have a 1-inch wingspan and are bright white with orange and black markings on the underside of their abdomens. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Hawthorn (*Crataegus*)—Leafroller

Includes
European (filbert) leafroller (*Archips rosana*)
Fruittree leafroller (*Archips argyrospila*)
Oblique-banded leafroller (*Choristoneura rosaceana*)
Pandemis leafroller (*Pandemis pyrusana*)

Pest description and damage Several species of leafrollers cause similar damage to host trees but differ in their appearance and, more importantly, in their life cycle. The leafroller pests on hawthorn are divided into single-generation moths, such as the fruit tree leafroller and the European leafroller, and two-generation moths, such as the oblique-banded leafroller and pandemis leafroller. The leafroller larvae are mostly green caterpillars

with a light brown to black head. Adults have distinctive bands or mottling on the wings. Leaftiers are similar in appearance, although larvae are up to 0.5 inch long, dirty white, with a brownish head. The tortricid moth larvae are noted for their violent backward wriggling – a means of escape. Newly hatched larvae also may work into blossoms and damage developing fruit, which then abort and fall off the tree. The larvae web the leaves and flowers together beginning in late April, and then feed on the developing fruit or flowers. Larvae also feed on the surface of ornamental fruits or berries.

For biology, life history, monitoring and management

See:

Cherry, flowering (*Prunus*)—Oblique-banded leafroller

See "Leafroller" in:

Common Landscape Pests

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Hawthorn (*Crataegus*)—Pear sawfly (pear slug)

California pear sawfly (*Pristiphora abbreviata*)
Pear slug (*Caliroa cerasi*)

Pest description and damage Pear slug is a European insect now found in most areas of the U.S. It attacks both pear and cherry and is found on mountain ash, hawthorn, and ornamental Prunus. The adult is a glossy black fly-like insect, about 0.2 inch in length. The larva initially resembles a small tadpole due to the olive-green slime that covers the body, and the head being wider than the rest of the body. Mature larvae are 0.375 inch in length and orange yellow. Larvae feed on the upper surface of leaves, skeletonizing them. Heavy feeding causes leaf drop, with reduction in vigor and yield, particularly on young trees. California pear sawfly is found occasionally defoliating pear trees. Larvae eat and expand on round holes in leaves that can result in a leaf with only the midrib remaining. These bright green larvae match the host leaf color and rest along the edges of feeding area. While considered a minor pest on hawthorn and in orchards, these pests can potentially defoliate ornamental pears.

For biology, life history, monitoring and management

See:

Pear (*Pyrus*)—Pear sawfly (pear slug)

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Hawthorn (*Crataegus*)—Scale insect

Several species including
Oystershell scale (*Lepidosaphes ulmi*)
San Jose scale (*Quadraspidiotus perniciosus*)

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Scale insects are common on many ornamental trees and shrubs as well as landscape plants. Adult female scales live under a shell-like covering that may resemble a "volcano," "barnacle," "hemispherical bump," "cotton puffs," "oyster shaped," or even flat with various dull colors and markings. They are found attached along the branches, twigs, leaves, needles or even fruit. Most scale insects measure from 0.0625 to 0.25 inch in length. Occasionally scales build up large enough numbers to cause damage to the host plant. These insects have piercing–sucking mouthparts that they inject into plant tissues to feed on plant juices. Large populations of scale can devitalize plants and retard growth, as well as discolor the foliage. Severe infestations can kill twigs. In many cases, large quantities of honeydew are produced, which makes leaves and underlying plants shiny and sticky. Sooty mold fungus may grow on the honeydew giving the plants a dirty, sooty appearance.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Hawthorn (*Crataegus*)—Spider mite

Tetranychus spp.

Pest description and damage Several species of spider mites can cause damage to hawthorn leaves. Appearance of these mites varies with the

species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Spider mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants are covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites feed on leaves, which results in stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Hawthorn (*Crataegus*)—Tent caterpillar

Forest tent caterpillar (*Malacosoma disstria*)
Western tent caterpillar (*Malacosoma californica*)

Pest description and damage The western tent caterpillar attacks a wide variety of plants including alder, ash, birch, cottonwood, and willow, as well as fruit trees and roses. The over 1-inch-long adult moths are attracted to lights at night. Mature western tent caterpillars can reach a length of about 2 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.625 inch in length, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

For biology, life history, monitoring and management

See:

Alder (*Alnus*)—Tent caterpillar

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Hellebore (*Helleborus*)—Aphid

Includes Hellebore aphid (*Macrosiphum hellebori*)

Pest description and damage Several species of aphid are reported from hellebore. The most common is hellebore aphid, a whitish-green aphid that measures 0.08 to 0.16 inch in length and forms dense clusters on the leaves, stems, or flowers, sometimes forming dense colonies. Aphids are often visible, but sometimes are on the undersides of the leaves. So, plants should be checked from time to time. Damage includes abundant honeydew and sooty mold or blackening of leaves, or viruses transmitted when the aphids feed.

Biology and life cycle The aphids are reported to overwinter as eggs, or as adults, and hatch in early spring. When the egg hatches, the aphid is called a stem mother. After maturing, she gives live birth to the young. They, in turn, mature and birth more live young. In this way, there may be waves of aphids of different sizes.

Monitoring Watch for signs of aphids: honeydew, sooty mold and the white shriveled caste off aphid exoskeletons, or for ants that are harvesting the honeydew. Syrphid fly larvae are found munching on the aphids in the spring. Often natural enemies and ants are noticed even before the aphids are seen. Aphids are partial to succulent new growth. They are common in spring but are reported in fall and winter as well.

Management--Cultural

Hosing off aphids with plain water can work where plants are potted or isolated in the landscape.

Management--Biological

Releases of lacewing larvae may have some success depending on the size of the aphid population.

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

For more information

See "Aphid" in:

Common Landscape Pests

Hemlock (*Tsuga*)—Coneworm and shoot moth

Dioryctria spp.

Pest description and damage Adult coneworms are mottled gray or brown snout moths banded with subtle waves of color and about 0.6 to 0.7 inch in length. The coneworm larvae are small and cream-colored or light brown with a darker head. Coneworms attack true firs by boring into shoot tips or stems, especially around wounds, and feeding on the soft bark tissues. The portion of the branch beyond the injured point may die back. Coneworms also may bore into green cones, feed on the soft bark of young growth, or feed inside the bark on the trunk cambium. There are many species of *Dioryctria* that feed on different parts of small plants, trunk, shoots, and cones. Confounding the issue, other orders of insects also attack cones and small moths that bore into shoots.

For biology, life history, monitoring and management

See:

Douglas-fir (*Pseudotsuga*)—Coneworm

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Hemlock (*Tsuga*)—Hemlock scale

Abgrallaspis ithacae

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Hemlock scales feed on the needles of Eastern hemlock (*Tsuga canadensis*) and spruces (especially Colorado blue). Adult scales are round to oval, dark gray or black, and about 0.1 inch in diameter. Immature scales (crawlers) are green to yellow. Scales are found as small bumps on the underside of needles. Scale insects feed on the needles by sucking out the cell contents. The initial symptom of infection is yellow spots on the upper surface of the needles. As few as four to six scales per needle can cause needle-drop. Colorado blue spruce loses large numbers of needles. Severe infestations may weaken trees sufficiently to cause death. The hemlock scale is most common on stressed trees.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Hemlock (*Tsuga*)—Hemlock woolly adelgid

Adelges tsugae

Pest description and damage Hemlock woolly adelgids are aphid-like insects that are about 0.0625 inch in length. They appear as white, woolly tufts on the bark, branches, and needles of twigs. Adults are black beneath the woolly waxy material. While needles may drop prematurely, weakening the tree and sometimes leading to death of branches, more often in landscapes infestations are limited to single branches without dire consequences. A few adelgids usually do not require action. Trees with severe infestations are stressed, predisposing them to other insect and disease problems. The hemlock adelgid is especially a problem on hemlock hedges.

Biology and life history The adelgid overwinters as woolly adults. Reddish-brown crawlers, like scale crawlers, appear in spring and early summer. Hemlock adelgids are known as "hemlock chermes."

Pest monitoring Inspect woolly areas for the presence of live adults or tiny black dots on the needles which indicate the crawlers are alive and active. Also, check for evidence of natural enemies.

Management—cultural control

Western hemlock (*Tsuga heterophylla*), mountain hemlock (*T. mertensifolia*), and Northern Japanese hemlock (*T. diversifolia*) are reported to be resistant to infestation. Eastern or Canadian hemlock is very susceptible. Wipe off minor infestations and prune out larger infestations if possible.

Management—biological control

Often the woolly material will appear dirty and disturbed. Look for syrphid larvae, white waxy ladybug larvae, lacewing larvae and other predators.

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Hemlock (*Tsuga*)—Pine needle scale

Chionaspis pinifoliae

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Pine needle scale insects are about 0.1 inch in length under elongate, white scales. These scale insects are found on and feed on the needles. Heavily infested trees may appear "flocked." Infested needles turn yellow, then brown. Twigs and branches are killed. Repeated infestations may kill trees eventually. While the pine needle scale is a serious pest of ornamental pines, it infests arborvitae, cedar, hemlock, spruce, and Douglas-fir.

For biology, life history, monitoring and management

See:

Pine (*Pinus*)—Pine needle scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Hemlock (*Tsuga*)—Root weevil

Many species

Pest description and damage Species identification is important as root weevil species differ in susceptibility to pesticides and have different life cycles. Adult weevils are dark colored, nocturnal beetles from 0.2 to 0.25 inch in length with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of needles. Tips may die beyond the point where weevils have girdled the twig. C-shaped white larvae may be a problem in forestry seedlings.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Holly (*Ilex*)—Aphid

Includes *Aphis* (*Toxoptera*) *aurantii* and others

Pest description and damage Several species of aphids can become problems as foliar, stem, flower, bud bark or root feeding pests. Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies, but most aphids tend to match host plant coloration. Aphids tend to feed in colonies and are found on the most succulent plant tissues. Feeding damage to shrubs, trees and mature plants is usually minor, but can compromise the vigor of the host, and some leaf and shoot distortion on new growth can occur if aphid populations are high. Aphids produce honeydew that encourages growth of a black sooty mold.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Holly (*Ilex*)—Brown soft scale

Coccus hesperidum

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant

preferences. Brown soft scale insects are found under yellowish to dark brown scales (adults are usually darker) that range from 0.1 to 0.2 inch in length. They are found on twigs, although young scales may be found on the foliage, typically on the underside of leaves along the leaf veins.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Holly (*Ilex*)—Cottony camellia scale

Pulvinaria floccifera

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The most visible stage of the cottony camellia scale is the adult female that resembles a flat, 0.125-inch diameter scale often found on the underside of a leaf. Emerging from beneath the adult female is an oblong cottony white egg mass that can be up to twice the length of the scale. The cottony camellia scale (sometimes called taxus scale) crawlers are flat brownish or yellowish sucking insects. Foliage with scale infestations may turn yellowish or pale in color. Due to copious honeydew, leaves below are covered with a crust of black sooty mold. It is possible to have low numbers of this insect for years without an outbreak.

For biology, life history, monitoring and management

See:

Camellia (*Camellia*)—Cottony camellia scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Holly (*Ilex*)—Holly bud moth

Rhopobota naevana

Pest description and damage The adult holly bud moth is a mottled brown and silver insect with a wingspan of approximately 0.5 inch. The larvae are greenish brown with dark heads and about 0.5 inch in length. The larvae roll and web leaves resulting in distorted leaf tip growth. Another name for the holly bud moth is blackheaded fireworm that also feeds on cranberry, blueberry, apple, and cherry.

Biology and life history Overwintering eggs hatch in the spring. The larvae begin feeding on buds, but soon move to leaves, which they roll and hold in place with webbing. Mature larvae drop from the plant and pupate in the duff. The second-generation females lay eggs singly on the underside of leaves, and larvae from these eggs emerge by the end of July. There are two generations per year.

Pest monitoring Thresholds for ornamental trees differ from those in commercial holly orchards and nursery settings. In landscape settings, damage is kept to a minimum by natural enemies. Leaf distortion is hardly noticed. Watch for the first sign of new growth, when holly bud moth larvae start tying leaves together.

Management—cultural control

Hand pick larvae when they are found in rolled leaves. When the bud moth larvae are well established and before they pupate, shear trees and hedges to remove the larvae and infested tips. Collect and destroy the debris.

Management—biological control

Little is known about natural enemies, but the low number of infested leaves in most years suggests they exist.

Management—chemical control

Do not spray holly in bloom. Apply listed insecticides (see: "Caterpillar" in Common Landscape Pests) when new growth is about 0.25 inch in length and before blossoms open.

See Table 2 in:

Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:

Common Landscape Pests

Holly (*Ilex*)—Holly leafminer

European holly leafminer (*Phytomyza ilicis*)
Native holly leafminer (*Phytomyza ilicicola*)

Pest description and damage These species of holly leafminer feed only on English holly (*Ilex aquifolium*) and American holly (*Ilex opaca*), respectively. Adults are small (0.06 inch in length), grayish black flies that emerge throughout May. Larvae are yellowish and about 0.06 inch in length. Characteristic damage by larvae includes the presence of yellow, brown, or reddish mines on the leaves. Initially, the mines are narrow and winding but become large blotches as the larvae continue to mine. They overwinter in the mine as mature larvae or pupae. The upper and lower leaf surfaces separate where the larvae have consumed the inner tissues.

Biology and life history These insects overwinter as larvae in the mined leaves and pupate in early spring. The adult flies emerge in May and the females poke the leaves with their ovipositor and feed on oozing liquid. This results in small yellow pits in the leaves. A few days later, females begin laying eggs on the undersides of leaves in the midvein. The eggs hatch, and the larva burrows into the leaf and commences making the mine. They continue mining through the late fall. There is one generation per year.

Pest monitoring With the first flush of the new growth, watch for small sunken spots where the female fly pokes the leaf with her ovipositor then turns and feeds on the juices. Initiate control to reduce the egg-laying adults.

Management—cultural control

Hand pick and destroy infested leaves in the fall.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more information

See "Leafminer" in:
Common Landscape Pests

Holly (*Ilex*)—Leafroller (Orange tortrix)

Orange tortrix (*Argyrotaenia franciscana*)

Pest description and damage The orange tortrix is a pest of many woody plants, including holly. Adults are buff-colored moths with wingspans of 0.5 to 0.75 inch. The larvae of the orange tortrix are light cream to green with light brown heads and are up to 0.5 inch in length at maturity. The feeding caterpillars typically roll or twist individual leaves or clusters of leaves at shoot tips and tie them into loose nests with webbing. They thrash about violently when disturbed. They are seldom abundant.

For biology, life history, monitoring and management

See "Leafroller and leaftier" in:
Common Landscape Pests

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Holly (*Ilex*)—Lecanium scale

Includes *Parthenolecanium corni*

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Lecanium scales are most noticeable as the female scales expand in size in the spring. As females swell in the spring, they produce large egg masses under their scales and release considerable honeydew that coats nearby foliage. The female lecanium scales are about 0.125 inch in diameter and vary from red to dark brown in color. They are oval and raised, resembling small "helmets," "turtles," or bumps on branches, stems, and the underside of leaves. Male scales are smaller, flat, and oblong. Crawlers are present on stems and leaves in summer and through fall and winter.

For biology, life history, monitoring and management

See:
Ash (*Fraxinus*)—San Jose scale

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Holly (*Ilex*)—Root weevil

Numerous species

Pest description and damage Identification is important as the numerous species differ in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Hollyhock (*Alcea rosea*)—Hollyhock weevil

Hollyhock weevil (*Rhopalapion longirostre*)

Pest description and damage The hollyhock weevil is native to southern-southeastern Europe and Asia Minor. It was found in Georgia in 1914 and is now well distributed throughout the U.S. This tiny (0.10 to 0.15 inch), long-snouted weevil is gray, and slightly hairy with orangish legs. Adults feed on leaves, causing small holes in the tissue. The long snout is adapted for feeding on seeds and buds. Look for slightly holy leaves and the paired weevils will be found around flowers and buds. Weevils reduce flower production and may reduce natural re-seeding in the garden. Weevil feeding damage is relatively minor in hollyhock.

Biology and life history The adult weevils mate in July and August. The female drills deep into the developing bud and lays eggs. Larvae develop in 4 to 6 weeks. They pupate in August and overwinter in the duff and litter, mostly as adults.

Pest monitoring Watch for either the first holes in leaves or the adults (often in pairs) around the flowers and buds. Holes in seed pods are also indicative of this insect.

Management—cultural control

Bend flower heads over a box and sharply strike the stem to knock adults off the plants. Pick off the adults as they do cling tenaciously. Remove (and destroy) buds before adults emerge in late summer or through the winter to catch late (spring) emerging adults.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

Kulzer, L. 1998. Bug of the month: hollyhock weevil. Scarabogram. (https://crawford.tardigrade.net/bugs/BugofMonth32.html)

Hollyhock (*Alcea rosea*)—Leafhopper

Several species

Pest description and damage Leafhoppers are slender, delicate sucking insects about 0.125 inch or less in length. They are distinguished by the ability of adults and nymphs to run forwards, backwards and sideways to escape danger. Leafhopper feeding on leaves results in damage that resembles small white to yellow stipples in leaves, leaf curling or virus symptoms, as some leafhoppers transmit virus diseases. Sometimes, the tips of hollyhock leaves may die and turn brown. Some leafhoppers exude copious honeydew. Normally, leaf stippling is not injurious to the plants unless the leafhopper carries a virus.

For biology, life history, monitoring and management

See "Leafhopper" in:
Common Landscape Pests

Hollyhock (*Alcea rosea*)—Spider mite

Twospotted spider mite (*Tetranychus urticae*) and others

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen, and coniferous ornamentals. Appearance

of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Twospotted mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants are covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites damage leaves and fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop.

For biology, life history, monitoring and management

See "Spider mite" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Honeylocust (*Gleditsia triacanthos*)—Honeylocust plant bug

Blepharidopterus chlorionis

Description and crop damage These small (about 0.15 inch in length) green plant bugs overwinter in the egg stage. As honeylocust buds expand, eggs hatch and nymphs feed on new growth. Adults are found a month after nymphs first appear; they too feed on new growth. Feeding can cause stippling and growth distortion. Heavy feeding can cause defoliation. There is one generation per year.

Management—physical control

Nymphs are knocked off leaves with a high-pressure spray of water.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Honeylocust (*Gleditsia triacanthos*)—Honeylocust pod gall midge

Dasineura gleditchiae

Pest description and damage The honeylocust pod gall midge is a tiny (0.1 inch) orange gnat. The small bright pink maggots feed within the galls that are deformed, thickened, and pod like leaves. The larvae are sheltered inside the deformed leaves. Infested leaves may dry and drop from the tree. Small shoots are killed. Although trees are unlikely to be killed, the ornamental quality of the tree may be lost. Thornless varieties of honeylocust are especially subject to damage. Damage from this gall maker is most noticeable in nurseries, but less objectionable in landscapes, especially if the tree is viewed from a distance.

Biology and life history The midge overwinters as pupae in cocoons in the upper two inches of soil near the base of the tree trunks (generally within one foot of the trunk). The adults emerge and form small swarms around the tips of leaves, as the trees are just beginning to leaf out. Adult midges deposit eggs on new foliage along the rachis or on the edges of developing leaf buds. The first pod gall midge eggs generally are found during the last week of March through the first week of April. The eggs usually hatch in two days. The young larvae crawl along the leaf and begin feeding. Only one larva is required to initiate galling of the leaf. Soon after this initial generation, the populations appear continuously with many life stages present. There are multiple generations each year, as little as three to four weeks apart.

Management—cultural control

Prune out infested growths.

Management—chemical control

See Table 3:
Chemical Control of Landscape Pests

For more information

See "Gallmakers" in:
Common Landscape Pests

Honeysuckle (*Lonicera*)—Aphid

Honeysuckle aphid (*Hyadaphis tataricae*)

Description and damage This tiny (adult size ranges from 0.04 to 0.01 inch in length) grayish-green aphid has a white abdomen dusted with a fine light powder. The head and thorax are slightly darker. Not the usual pear shape, these aphids have very short cornicles and are shaped more like a manatee. The aphids suck on tender new growth and flowers that can result in stunted leaf and stem growth then witches' brooms and brown dead tips.

Biology and life history This aphid is reported to overwinter as eggs near the damaged tips of infested plants. With the onset of new growth, the

first of several generations of aphids hatch and begin feeding. They feed within the protection of curled leaves and flower clusters. These aphids spend their entire life on honeysuckle, littering the tips with cast off aphid exoskeletons. In fall, winged males mate with wingless female that lay eggs for the next season.

For monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Hydrangea (*Hydrangea*)—Root weevil

Various species

Pest description and damage Identification is important as each species differs in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles, from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size. The larvae are rarely a significant problem in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Iris (*Iris*)—Bulb mite

Rhizoglyphus echinopus

Pest description and damage Mature bulb mites vary from about 0.02 to 0.03 inch in length and have four pairs of legs. Their bodies are shiny, white, somewhat transparent, and smooth with reddish brown appendages. They are found in colonies. Their oval shape and sluggish behavior can deceive the human eye into identifying them as eggs. They avoid the light and hide under damaged or diseased tissue. Rhizomes infested with bulb mites may rot and fail to produce new growth, or new growth may be off-color, stunted, and distorted. Although the bulb mite is not considered a primary pest of rhizomes, it is often responsible for serious losses; the slightest injury to the rhizome will allow bulb mites to enter and become established. Once the mites are inside, they rapidly turn the rhizomes into rotten pulp. Injured or bruised rhizomes are the most susceptible to damage. Not only do mites destroy tissue, but they also carry fungi and bacteria that often spur additional damage. Millipedes may move into the rotting rhizomes which confuses the diagnosis.

For biology, life history, monitoring and management

See:

Tulip (*Tulipa*)—Bulb mite

Ivy (*Hedera*)—Aphid

Includes *Aphis hederae* and others

Pest description and damage Several species of aphids can become problems as foliar, stem, flower, bud bark or root feeding pests. Aphids tend to be small (.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies but most aphids tend to match host plant coloration. Aphids tend to feed in colonies and are found on the most succulent plant tissues. Feeding damage to shrubs, trees and mature plants is usually minor, but can compromise the vigor of the host, and some leaf and shoot distortion can occur if aphid populations are high. Aphids produce honeydew that encourages growth of a black sooty mold.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Ivy (*Hedera*)—Root weevil

Numerous species

Pest description and damage Identification is important as each species differs in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Ivy (*Hedera*)—Spider mite

Includes twospotted spider mite (*Tetranychus urticae*) and others

Pest description and damage Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Twospotted mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants are covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites damage leaves and fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Japanese holly (*Ilex*)—Root weevil

Numerous species

Pest description and damage Identification is important as each species differs in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Japanese holly (*Ilex*)—Spider mite

Includes twospotted spider mite (*Tetranychus urticae*) and others

Pest description and damage Several species of spider mites can cause damage in Japanese holly especially in dry sites. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Twospotted mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants are covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites damage leaves feeding on plant cells, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Juniper (*Juniperus*)—Aphid

Giant conifer aphid (*Cinara* spp.)

Pest description and damage These are large aphids, up to 0.2 inch in length. Their color may range from gray to brownish to dark. Aphids establish large colonies on the twigs but are found feeding on leaf scales. Their feeding and honeydew production can cause sooty mold problems on foliage and nearby surfaces and reduce the ability of plants to produce sugars.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Juniper (*Juniperus*)—Cypress tip moth

Includes Cypress tip moth (*Argyresthia cupressella*)

Pest description and damage There are nine *Argyresthia* species that attack different conifers (pine, hemlock, etc.) in the Pacific Northwest. One of them, the adult cypress tip moth (cypress tip miner) is common enough to merit attention in many books. The moth is silver-tan and approximately 0.3 inch in length. The mature larvae are green, about 0.3 inch in length. The larvae tunnel in the growing points of the 1- and 2-year-old shoot tips. The cocoon is a white, somewhat papery structure made in dead or living foliage. Damage typically is limited to the tips of twigs. The exit holes are dark and may resemble symptoms of *Didymacella* leaf blight, a fungal disease. Foliage does not discolor in the affected areas until late winter. After this, the brown, dead twigs break off readily. Cultivars of *Juniperus chinensis, J. virginiana,* and *J. sabina* also are affected. The entire plant can appear brown in a severe infestation, and repeated infestations cause dieback. Failure to gain control may require taxonomic identification to ensure the right species is identified. Juniper can recover from extensive feeding damage from these moth larvae.

Biology and life history Adult moths appear on plants around May–June. Eggs are laid on the shoot tips of host plants. The larvae tunnel under the leaf scale and feed in the foliage until the following spring. Larvae leave the mines in spring and spin a white cocoon in which they pupate. After several weeks, the adult moths emerge. There is one generation per year.

Pest monitoring Watch for larvae ballooning from the plant on a silk thread or moths flying around the plants. A sticky coated plate hung horizontally provides easy means of monitoring for small "worms" when they exit.

Management—cultural control

Resistant cultivars are available.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Juniper (*Juniperus*)—Juniper scale

Carulaspis juniperi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The female juniper scale insect is approximately 0.05 to 0.1 inch in diameter beneath a white scale with a notable, central yellow spot. The male scale has a more elongated appearance. Crawlers are pale yellow. This insect feeds on the sap within the stem or leaf. Leaves, twigs, branches, and cones are attacked. Their feeding can reduce the vigor of the foliage supported by that stem. Symptoms of scale feeding include loss of normal color and luster of foliage, no new growth, and yellowing and death of branches. Severe infestations may kill entire plants. Juniper (*Juniperus*), Leyland cypress (*Cuppressocyparis*), Lawson cypress (*Chamaecyparis*), western red cedar (*Thuja*), and all members of the Cupressaceae family are attacked.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Juniper (*Juniperus*)—Juniper tip midge

Oligotrophus betheli

Pest description and damage The adult is a tiny (about 0.06 inch in length), yellow, mosquito-like fly. The larva is a maggot that lacks legs or a definite head. Juniper tip midge larvae feed within the tips of shoots, causing them to swell and form tiny green galls. After the larvae have left, the galls turn brown (sometimes reddish) and the tips die back. Symptoms of mining and exit holes are found at the junction between living and dead tissue or at the base of the swollen portion. The damage may appear very similar to that caused by fungal pathogens in the genus *Phomopsis*.

Management—cultural control

Remove green galls and damaged tips while larvae are still in the galls.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more management options

See "Gallmakers" in:
Common Landscape Pests

Juniper (*Juniperus*)—Juniper webworm

Dichomeris marginella

Pest description and damage The adult juniper webworm is a copper-brown moth with white bands on the edges of the front wings. The moth is about 0.5 inch across. The mature larva is a yellowish to brownish caterpillar, 0.05 to 0.06 inch in length, with dark brown lines on the back and a dark head. The webworm caterpillars initially feed by mining inside leaves, then gather to feed in small colonies or nests of webbed foliage as they mature. Due to their habit of feeding deep in the plant canopy, damage is overlooked. Damaged foliage turns brown and is covered with dirty webbing. Considerable amounts of foliage are spun together, and small trees may be completely webbed. Frequently, damage is observed in early spring from March to May. This pest infests only junipers.

Biology and life history The caterpillars overwinter in the nest, which consists of webbed twigs, as well as silk tubes through which the caterpillars move through the juniper foliage and webbing. These larvae resume feeding in spring then pupate. Adult moths fly in late spring. Eggs are laid on leaves of the current season's growth. Larvae feed first as leafminers, then feed on the surface of leaves while building silken tubes around the feeding site. They overwinter in small groups within these webbed sites. There is one generation per year.

Pest monitoring Watch for the first signs of webbing.

Management—cultural control

Hand-pick caterpillars and prune out infested growth. Irish juniper (*J. chinensis* 'Stricta') is the preferred host, although Chinese juniper, red cedar, and *Juniperus communis* varieties *aurea, horizontalis, depressa, hibernica, suecia,* and J. *squamata* 'Meyeri' are infested. *Juniperus procumbens* and *J. squamata* are infested only occasionally.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Juniper (*Juniperus*)—Root weevil

Numerous species

Pest description and damage Identification is important as root weevil species differ in susceptibility to pesticides and may have different life cycles. Adult weevils are dark colored, nocturnal beetles from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. The tell-tale ragged notches are inconspicuous on juniper; however the weevils often girdle the twig, resulting in dead tips.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Juniper (*Juniperus*)—Spider mite

Tetranychus spp.

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen, and coniferous ornamentals. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Twospotted mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants may be covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites damage fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Kinnikinnick (*Arctostaphylos*)—Aphid

Includes manzanita leaf gall aphid (*Tamalia coweni*)

Pest description and damage These aphids are grayish or greenish, 0.04 to 0.06 inch in length, and prefer to feed on new plant growth. The manzanita leaf gall aphid feeds on the leaves of kinnikinnick and other manzanita species (Arctostaphylos spp.). Aphid feeding causes the leaves to thicken and form bright red galls. Older galls turn brown. Severe infestations may slow the growth of the plant. Non-gall-forming aphids are seen occasionally on kinnikinnick. They are greenish, soft-bodied insects that may feed on leaves or stems. Honeydew, a sweet, sticky material, may be associated with aphid feeding. Honeydew attracts ants and becomes covered with a growth of dark, sooty mold. Severe infestations may result in leaf and twig dieback. After the aphids leave, the tips turn brown as the galls age.

Pest monitoring Watch for the first sign of aphids with the onset of new growth in spring, or at other times of new growth flushes. Yellow sticky cards are attractive to aphids and will serve as an early warning.

Management—cultural control

Galls tend to form at the tips of branches; prune or shear off galls while they are still green, and the aphids will die quickly. Avoid frequent shearing and over fertilization, which encourages succulent new tip growth favored by aphid. For other aphid pests, wash aphids from plants with a strong stream of water or by hand-wiping.

Management—biological control

Syrphid fly larvae are predators of the leaf gall aphid and will feed on the aphids inside the galls. Avoid use of broad-spectrum insecticides that also kill the beneficial insects such as lady beetles and parasitic wasps.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

See "Gallmakers" in:

Common Landscape Pests

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Kinnikinnick (*Arctostaphylos*)—Root weevil

Numerous species

Pest description and damage Identification is important as root weevil species differ in susceptibility to pesticides and may have different life cycles. Adults of most of the species are all females and capable of laying eggs after a period of feeding to mature their ovaries. Larvae, found around roots, are C-shaped, legless, and white, or slightly reddish, with tan heads, up to 0.5 inch in size. All species are quite similar in appearance and habits of feeding on root hairs, larger roots, and root crown. Adult weevils are dark colored night feeders, from 0.2 to 0.25 inch in length, that mostly remain in the soil or in debris at the base of the plant during the day, then climb up to feed on leaves at night. Look for ragged notches on the edges of leaves, or flower petals or dead tips of plants where weevils have girdled the twig.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Laurel, Portuguese (*Prunus*)—Carnation tortrix

Cacoecimorpha pronubana

Pest description and damage Portuguese laurel (*Prunus lusitanica*) is sometimes infested with the larvae of the carnation tortrix. This is a small (wingspan 0.5 to 0.9 inch), bell-shaped brown moth with reddish underwings and dark bands on the upper wings. The caterpillars are light brown or greenish with brown heads and are about 0.375 to 0.5 inch in length at maturity. The larvae feed by rolling leaves and tying them with webbing. The larvae are very active when disturbed, often wriggling backwards. The carnation tortrix attacks many broad-leaved plants but seldom causes serious damage. Outside the U.S., it is reported to be a serious pest of carnations.

Biology and life history Adult females lay yellow, flattened oval-round eggs in groups of ten to 200 for a total of 500-700. Eggs take five to 55 days to hatch. Larvae are active year-round and can disperse by ballooning on the wind. Pupation takes 10 to 15 days.

For biology, life history, monitoring and management

See "Leafroller and leaftier" in:
Common Landscape Pests

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Laurel, Portuguese (*Prunus*)—Peachtree borer

Synanthedon exitiosa

Pest description and damage Peach tree borer is native to North America and common in the Pacific Northwest. The adult is a metallic blue-black, clearwing moth. The male moth with a 1-inch wingspan may have bands of light-yellow scale on the abdomen, which makes it resemble a wasp. The female has a 1.25-inch wingspan and an orange band around the abdomen. Full-grown larvae are 1 inch in length and whitish with a brown head. The larvae burrow into the bark of the root crown and feed on the cambium. Feeding is restricted to an area a few inches above and below the soil line. Peachtree borer feeding damage can girdle and kill young trees. Feeding damage rarely girdles older trees but does reduce vigor and makes these trees vulnerable to other pests and diseases.

For biology, life history, monitoring and management

See:
Peach, flowering (*Prunus*)—Peachtree borer

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Lilac (*Syringa*)—Ash borer

Lilac and ash borers (*Podosesia syringae*)

Pest description and damage The lilac borer, also called the ash borer, is a clearwing moth that attacks lilac, privet and other members of the olive family. The adult moth ranges from 1 to 1.25 inches in length and resembles a paper wasp, with orange and yellowish markings on a black body. Initially a thin wet stain forms around the entry hole, but later a mix of frass and sap forms. Areas around the entry site may become sunken and frass and sawdust may accumulate around the base of plants. Eventually, plants show branch dieback, weaken, or die. Borer holes are also entry for turkey-tail fungus (*Trametes versicolor*), which can further damage plants. Damage may be swift or slowly progressive.

Biology and life history Adult clearwing moths emerge in spring from a round hole at the top of their gallery. They mate and lay eggs on the bark at the base of plants and the young larvae tunnel under the bark.

Pest monitoring Deploy pheromone traps in spring to determine when the moths emerge. Watch for wet sunken areas in the bark at the base of the tree/bush. Often the pupal case will still protrude from the exit hole. Spotting even old damage will provide some indication of how heavy the infestation is and inform the next season's strategy.

Management—cultural control

Pheromone traps are available for this pest and will attract males thus preventing mating. Prune out infested branches during fall or winter when moths are not active as the moths often seek out injured areas on the bark. (Do not compost as moths may still emerge). Insert a knife or wire into the borer hole to kill larvae and pupae. Be sure to make good pruning cuts to speed wound closure.

Management—biological control

Entomopathogenic nematodes are available. They are sprayed at the base of trees over entry wounds so the nematodes can find their way into the galleries.

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

For more information

See "Wood Borers" in:

Common Landscape Pests

Missouri Botanical Garden. Lilac borer and ash borer (http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/help-for-the-home-gardener/advice-tips-resources/pests-and-problems/insects/caterpillars/lilac-borer-and-ash-borer.aspx)

Lilac (*Syringa*)—Lilac leafminer

Gracillaria syringella

Pest description and damage The adult insect is a golden yellow moth about 0.5 inch in length. The larvae are small, white to pale yellow or greenish caterpillars, 0.125 to 0.25 inch in length. The larvae mine leaves during the early part of their development. During later stages of their development, they are also responsible for rolling leaves and skeletonizing them. Privet (*Ligustrum*), *Deutzia*, *Euonymus*, mountain ash (*Sorbus*), and ash (*Fraxinus*) are attacked. Occasionally, lilac leafminer builds to damaging populations but typically, only a few scattered leaves are infested.

Biology and life history Lilac leafminer overwinter as pupae in rolled leaves, or possibly as a larvae in a dropped leaves. Adult moths emerge with new growth and lay eggs along the veins on the underside of leaves. The larvae hatch and commence mining the leaves forming blotches on the leaf surface. When the larvae emerge from inside the leaf, they roll the leaf over their bodies with silk and continue feeding. Later, they select an undamaged leaf, roll it up, and pupate in it. The adult moth emerges about a week later. There may be several generations per year.

Pest monitoring As new growth comes out in spring, watch for the first small brown mines. Note that the presence of multiple mines in spring could be the harbinger of a heavier leafminer infestation in midsummer and worse in fall.

Management—cultural control The larvae in the mines may be squashed by pinching them while they are still in the leaf mines.

Management—biological

Often the mined leaf harbors a parasitoid feeding on the lilac leafminer larvae and no moths will emerge. There is conflicting information on the wisdom of raking up leaves in fall. While it may remove pupating lilac leafminers, it may also remove parasitoids.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

For more information

See "Leafminer" in:

Common Landscape Pests

Lilac (*Syringa*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature insect is approximately 0.125 inch long beneath a brown, or gray scale that is usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs of many broad-leaved deciduous plants. They occur less frequently on the leaves and other plant parts. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Newly emerged crawlers look like bright white pimples on the bark. Stressed trees where the scales encrust entire branches suffer the greatest damage.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Oystershell scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Lilac (*Syringa*)—Root weevil

Lilac root weevil (*Otiorhynchus meridionalis*) and numerous other species

Pest description and damage Identification is important as root weevil species differ in susceptibility to pesticides and may have different life cycles. Adult weevils are from 0.2 and 0.25 inch long, dark colored and nocturnal, East of the Cascades, the lilac weevil is especially common. Look for regular U-shaped notches along the leaf edges. This species is unusual because males are common, and adults are found in tandem. These nocturnal adults are nearly black and shiny with a snout (rostrum) and elbowed antennae. Larval feeding on roots is rarely a problem in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Lily (*Lilium*)—Aphid

Foxglove aphid (*Aulacorthum solani*)
Green peach aphid (*Myzus persicae*)
Melon aphid (*Aphis gossypii*)

Pest description and damage Several aphid species are pests of lilies. Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. These aphids feed in colonies on the leaves. Feeding damage to the plant is usually minor, although some leaf and shoot distortion can occur if populations are high.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Lily (*Lilium*)—Lily leaf beetle

Lilioceris lilii

Pest description and damage This bright red leaf beetle is new to the PNW and is currently only known from a few locations in Bellevue, Washington. The adult beetles are 0.4 to 0.5 inch in length, shiny as though lacquered. Eggs are bright red, dimming to dull orange-brown before they hatch. The larvae are covered in their own gooey excrement and look like a glob of slime. Adults chew ragged holes in the leaves and petals and the larvae scrape the leafy tissue from the surface. Eventually the leaf wilts down to nothing.

Biology and life history Adults emerge early in spring as the first lily shoots appear. They mate and lay eggs immediately. Adults are found well into summer with continuous eggs and larvae.

Pest monitoring Inspect ground as new shoots emerge and remove any adults found.

Management—cultural control

Remove larvae as noticed; select lilies most resistant cultivars and species. Asiatic lilies are highly favored.

Management—biological control

None known from this area.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Leaf beetles" in:
Common Landscape Pests

Linden (*Tilia*)—Aphid

Includes linden aphid (*Eucallipterus tiliae*)

Pest description and damage The linden aphid is about 0.07 to 0.12 inch in length and green with black lateral stripes. The aphids feed in colonies on the undersides of leaves. Feeding damage to the plant is usually minor, although some leaf and shoot distortion can occur if populations are high. This aphid also produces honeydew, which is a nuisance when it falls on cars or other surfaces. This aphid is controlled by releasing parasitoids.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Linden (*Tilia*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature the caterpillars are over 1.25 inch in length, covered with yellow, rusty then black colored silky hairs. Adult moths have a 1-inch wingspan and are bright white with orange and black markings on the underside of the abdomen. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Linden (*Tilia*)—Lecanium scale

Includes *Parthenolecanium corni*

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Lecanium scale insects are most noticeable as the female scales expand in size in the spring. As females swell in the spring, they produce large egg masses under their scales and release considerable honeydew that coats nearby foliage. Female lecanium scales are about 0.125 inch in diameter and vary from red to dark brown in color. They are oval and raised, resembling small "helmets," "turtles," or bumps on branches, and stems. Male scales are smaller, flat, and oblong. The crawlers are pale yellow and feed on the undersides of leaves. They also produce honeydew.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Lecanium scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Linden (*Tilia*)—Linden gall mite

Eriophyes tiliae

Pest description and damage A very tiny (less than 0.008 inch) eriophyid mite that causes elongated, red to greenish pimple-like galls (about 0.3 inch in length) on leaves. Damage is seldom serious.

Management—biological

Predatory mites are important biological control agents.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more information

See "Gallmakers" in:
Common Landscape Pests

Linden (*Tilia*)—Spider mite

Tetranychus spp.

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen, and coniferous ornamentals. Appearance of these mites varies with the species, although all are 0.02 inches or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Spider mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants may be covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites damage leaves and fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Locust (*Robinia*)—Carpenterworm

Prionoxystus robiniae

Pest description and damage Carpenterworms are the larvae of large, mottled gray and black moths (commonly called goat moths) whose size ranges from 1.75 to 3.0 inches in length. The caterpillars are white to pinkish red with a dark head and are 1 to 3 inches long when mature. The caterpillars bore in the trunk and main branches. Discolored or bleeding limbs, branch dieback, and lumpy or gnarled trunks may be indications of infestation. Typical symptoms of carpenter infestation include sawdust-like material (frass) and wood chips mixed with loose webbing. Trees with severe carpenterworm infestations are susceptible to wind breakage and are removed to reduce safety risks.

For biology, life history, monitoring and management

See:
Cottonwood (*Populus*)—Carpenterworm

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Locust (*Robinia*)—Locust borer

Megacyllene robiniae

Description, biology and damage This is a serious pest of black locust. An attractive yellow and black longhorned beetle (0.75 inch in length) which can be seen on goldenrod and rabbit brush in the fall. In fall, the adults lay eggs in cracks and in wounds on the bark. Locust borer larvae are white and legless, reaching a maximum length of about 1 inch. Larvae mine beneath bark and in wood and can literally honeycomb the wood so that infested limbs are likely to break (with or without a wind).

Pest monitoring Look for wet spots as sap seeps from the bark when larvae tunnel into the bark in spring. As larvae bore into wood, sawdust is forced out the entry hole.

Management—cultural control

Keep trees vigorous with adequate water and limit damaging agents such as animals. Remove weak or infested trees and grind or burn infested branches before beetles emerge.

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Madrone (*Arbutus*)—Leafminer

Madrone shield bearer (*Coptodisca arbutiella*)
Serpentine leafminer (*Marmara arbutiella*)

Description, biology and damage The serpentine madrone miner adult is a tiny (about 0.2-inch wingspan) moth. Larvae of this leaf- and twig-mining moth blaze sinuous, serpentine mines across the surface of leaves. Although damage might be unsightly on individual leaves, they do not affect the long-term health of the tree. This moth affects madrone throughout its range. The madrone shield bearer forms small dark areas on the upper leaf surface. When ready to pupate, the larvae cut two oval pieces of leaves (upper and lower leaf surface), stitches them together with silk, and moves with this case to a protected location and pupates within. The adult moth is gray with three horizontal stripes and has a 0.3-inch wingspan. These two insects generally occur in low numbers. Occasionally, there is a flare-up in either population that crashes by the next season due to natural controls.

Pest monitoring Leafminers usually are scattered in low numbers throughout the trees. Usually, only a few mines are found.

Management—cultural control

Remove infested leaves if they are bothersome; or tolerate minor blemishes that do not harm the tree.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Madrone (*Arbutus*)—Root weevil

Otiorhynchus spp.

Pest description and damage Species identification is important as root weevil species differ in susceptibility to pesticides and can have different life cycles. Adult weevils are dark colored, nocturnal beetles, from 0.2 and 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Larvae are rarely a problem in landscapes. Look for ragged notches on the edges of leaves on young trees, or dead tips of plants where weevils have girdled the twig.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Maple (*Acer*)—Aphid

Norway maple aphid (*Periphyllus lyropictus)*
Common maple aphid (*Periphyllus testudinaceus*)

Description, damage, biology and life history These 0.1-inch-long aphids on maple are most severe in the spring. This aphid usually develops wings and flies from the host in spring about the time it is reaching noticeable numbers. The aphids return in fall, congregating at the base of the tree. Honeydew production is usually the most noticeable problem with these aphids. When numbers of aphids are high, look for small gnat-like insects patrolling the leaves. These are parasitoid wasps seeking aphid hosts.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Maple (*Acer*)—Carpenterworm

Prionoxystus robiniae

Pest description and damage Carpenterworms are the larvae of a large, mottled gray and black moth (commonly called goat moths) whose size ranges from 1.75 to 3.0 inches in length. The caterpillars are white to pinkish red with a dark head and are 1 to 3 inches long when mature. The caterpillars bore in the trunk and main branches. Discolored or bleeding limbs, branch dieback, and lumpy or gnarled trunks may be indications of carpenterworm infestation. Symptoms of tree infestation include sawdust-like material (frass) and wood chips mixed with loose webbing. Trees with

severe carpenterworm infestations are susceptible to wind breakage and are removed as safety precautions. Infestations may kill trees eventually.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Carpenterworm

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Maple (*Acer*)—Cottony maple scale

Pulvinaria innumerabilis

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Mature cottony maple scale insects are relatively large, flat, oval, brown scales 0.25 to 0.375 inch in diameter. The "cotton" is waxy threads covering as many as 1,500 eggs. The developing females and nymphs produce copious amounts of honeydew that can collect on foliage and branches and cause growth of sooty mold. Honeydew is also a nuisance when it falls on nearby cars and sidewalks, and it attracts bees, wasps, and ants. Occasionally, heavy outbreaks of this scale occur, usually on weakened or stressed trees. Cottony maple scale reaches epidemic numbers on silver maple, but noticeable populations can occur on red maple. It survives on other species of maple, honey and black locust, white ash, euonymus, oak, boxelder, dogwood, hackberry, sycamore, beech, elm, willow, basswood, and poplar.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Maple (*Acer*)—Maple bladder gall mite

Maple bladder gall mite (*Vasates quadripedes*)

Description, biology and damage The maple bladdergall mite is a microscopic (less than 0.006 inch in length) eriophyid mite that feeds on the underside of leaves. Infested leaves initially develop small depressions that soon grow into brilliant red bladder-like galls at 0.125 to 0.2 inch in length. Later in the season, the galls may turn green or black. Silver and red maples are particularly susceptible to bladdergall mites. Severe infestations may cause leaf distortion. Although an aesthetic concern, bladdergalls are seldom harmful to the trees. Occasionally trees may be defoliated (trees drop their leaves to rid themselves of mites); this is an effective "strategy" of the plant to rid itself of these parasites. Trees often recover without galls in the next year.

Biology and life history The mites overwinter in cracks and under bark scale and begin feeding in spring after leaves emerge. Mite activity typically stops by around July.

Management—cultural control

Hand pick severely infested or distorted leaves to improve appearance of small trees if needed. A few galls will not impact the overall health of the tree.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

For more information

See "Gallmakers" in:

Common Landscape Pests

Maple (*Acer*)—Leafcutting bee

Numerous species in the family Megachilidae

Description and crop damage Leafcutting bee activity is noted by the uniform oval and round pieces cut from the edges of leaves. The adult bee is about 0.4 inch in length, black with white stripes and uses these little oval plant pieces to line the sides of an old beetle gallery or hole in the ground. She then gathers pollen to form a ball of food, and lays one egg, then seals the apartment with a wall made of a round leaf piece. Damage is transitory on young developing leaves. Once leaves have hardened off, the leaf cutters will find other suitable hosts.

Management—cultural control

If the missing leaf portions are objectionable, try laying a light sheet or fine curtain netting over the plant until the leaves have hardened off, or the bees have found another suitable leaf donor. The trade-off between pollination services provided by the leafcutting bees and the damage can be a positive one. Plants are not harmed by this loss of leaf tissues.

Maple (*Acer*)—Maple tip moth (Maple twig borer)

Proteoteras aesculana

Description and damage This moth has a wingspan of 0.5 to 0.7 inch and is dark olive-green with yellow and gray mottling. The mature larvae are about 0.4 inch in length with a whitish body, dark brown head, and yellow-brown thoracic shield. Larvae bore into tips of branches and the terminal shoot causing dieback as the leaves wilt and turn brown. Damage is most evident on young trees after the terminal is killed and the growth structure altered.

Biology and lifecycle In Oregon, larvae emerge in July and pupate in August. The maple tip moth appears to overwinter in the adult stage. In spring, the moths lay eggs near the tips of branches. Come May, the first evidence of tip dieback occurs as the caterpillars bore into and feed within the shoots.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Maple (*Acer*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature oystershell scale is approximately 0.125 inch in length under a pinkish brown or gray scale that is usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs of many broad-leaved deciduous plants. They occur less frequently on the leaves and other plant parts. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Newly emerged crawlers look like bright white pimples on the bark.

For biology, life history, monitoring and management

See:
Ash (*Fraxinus*)—Oystershell scale

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Maple (*Acer*)—Root weevil

Various species

Pest description and damage Identification is important as these species differ in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles from 0.2 and 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size. The larvae are rarely a significant problem in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

Chemical Control of Landscape Pests

Maple (*Acer*)—Rose leafhopper

Includes *Edwardsiana rosae*

Pest description and damage Rose leafhoppers are small (0.14 to 0.16 inch in length), active, whitish-green insects which run backwards, forwards or sideways when disturbed. The nymphs (immature) are white with red eyes. Rose leafhoppers feed on the leaves, causing white or pale blotches that resemble, but are larger than, spider mite stippling. Injured leaves may drop prematurely. The egg-laying in the fall also wounds the canes, providing entry points for fungal pathogens. Cast skins are found on the underside of leaves. Leafhopper damage is mostly aesthetic though there are occasional outbreaks.

For biology, life history, monitoring and management

See:
Rose (*Rosa*)—Rose leafhopper

See "Leafhopper" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Maple (*Acer*)—Satin moth

Leucoma salicis

Pest description and damage The adult moth (over 1-inch wingspan) is satiny white with black markings on the legs. The attractive larvae are approximately 2 inches long when grown and reddish brown with double white dorsal patches and tufts of hairs along the sides. They can seriously skeletonize then defoliate cottonwood, poplar, and willow. They occasionally attack oak and aspen. Lombardy poplar and silver maple are particularly susceptible.

For biology, life history, monitoring, and management

See:
Poplar (*Populus*)—Satin moth

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Maple (*Acer*)—Western boxelder bug

Boisea rubrolineata

Pest description and damage The boxelder bug is often a nuisance pest around and in homes where boxelder is commonly grown. The adult boxelder bug is a red, flat, and elongated bug about 0.5 inch in length. The front wings and thorax are gray-black to black with thin bright red markings. The eggs are red. The bright red nymphs look like the adult but without wings and smaller. These bugs feed on the leaves, flowers, and seedpods of the boxelder tree (*Acer negundo*), and on other maple species and ash. They may also feed on the fruits of apple, cherry, peach, pear, and plum trees. Large numbers of the bug usually occur only on female boxelder trees. They do little damage to ornamentals, though they can cause some leaf distortion.

Biology and life history In spring, the overwintered females lay eggs in the cracks and crevices of the boxelder tree's bark, and the nymphs hatch in a few days. The nymphs feed, grow and develop into adults during the summer. They then mate and lay eggs that hatch into the second-generation nymphs. Most of the nymphs of the second generation grow to full size by August and September. In autumn, the adults seek overwintering places in dry, sheltered hollow tree trunks, under rocks, boards, and other debris, in cracks and crevices in walls, in door and window casings, around building foundations and inside houses. They become a nuisance outdoors in patios or indoors when they invade homes in significant numbers.

Management—cultural control

Removal of seed pods of boxelder trees from the ground around the trees may help. Replacement of maple and boxelder trees with other tree species that do not produce as much seed will reduce populations. Where boxelder bugs become a nuisance as congregations on house walls, patios, decks, or storage areas, use a vacuum to remove them.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Maple (*Acer*)—Western flower thrips

Frankliniella occidentalis

Description, biology and damage Adults are yellow to yellow-brown, 0.05 inch in length, narrow, with wings. Larvae are smaller and wingless. Both stages feed on developing growth causing leaf distortion and black necrotic tissue. Most damage to maple occurs when thrips disperse from grass and hay fields as they are mowed or harvested in the summer.

For biology, life history, monitoring and management

See "Thrips" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Mountain ash (*Sorbus*)—Aphid

Includes Green apple aphid (*Aphis pomi*) and others

Pest description and damage Several species of aphids can become problems as foliar, stem, flower, bud bark or root feeding pests on broad-leaved trees. Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies (black, green, pink, yellow, mottled, striped, etc.), but most aphids tend to match host plant coloration. Aphids often feed in colonies and are found on the most succulent plant tissues. Feeding damage to shrubs, trees and mature plants is usually minor, but can compromise the vigor of the host, and some leaf and shoot distortion can occur if aphid populations are high.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Mountain ash (*Sorbus*)—Apple-and-thorn skeletonizer

Choreutis pariana

Pest description and damage Larvae are 0.5 inch in length, yellowish to greenish, with black spots and a yellow-brown head. Pupae are yellow to brown with a white silken cocoon. The larvae skeletonize and roll leaves from the side. Damaged leaves are brown and papery and drop prematurely. Damage varies from inconsequential to serious, so monitoring is an important management tool. Adult moths are reddish brown, with a wingspread less than 0.5 inch, and irregular light and dark bands on the wings.

For biology, life history, monitoring and management

See:

Crabapple (*Malus*)—Apple-and-thorn skeletonizer

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Mountain ash (*Sorbus*)—Cherry bark tortrix

Enarmonia formosana

Pest description and damage Cherry bark tortrix is a pest of most woody ornamental trees and shrubs in the family Rosaceae. The larvae are 0.33 to 0.4 inch in length, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a yellowish-brown head. Larvae feed directly on the cambium tissues under the tree bark and may cause death of the tree in sufficient numbers. Otherwise, the feeding activity decreases the supply of nutrients to the tree and increases susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the exuding of reddish-brown gum-like resin, which often is mixed with fecal pellets and silk. The trunk and larger limbs of bearing fruit trees are affected at pruning wounds or graft unions. The adult moth has a wingspan of about 0.33 inch and is a mottled yellow, cream and brown in appearance.

For biology, life history, monitoring and management

See:

Cherry (*Malus*)—Cherry bark tortrix

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Mountain ash (*Sorbus*)—Pearleaf blister mite

Eriophyes (*Phytoptus*) *pyri*

Pest description and damage The pearleaf blister mite is a very tiny (less than 0.006 inch in length), white, sausage-shape eriophyid mite. They are seldom visible to the unaided eye. Eriophyid mites feed on the underside of mountain ash leaves and cause the development of blister-like fuzzy patches on the upper leaf surface. These raised spots are generally light green, round, and look somewhat wrinkled. Older leaf blisters may turn brown. Severe infestations may result in premature leaf drop, but normally this is an inconsequential pest.

Management—cultural control

A strong, direct spray of water may wash mites from trees and reduce dust, which seems to favor eriophyid mite infestations. Hand-pick infested leaves to improve the appearance of small trees.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Mountain ash (*Sorbus*)—Mountain ash sawfly

Pristiphora geniculata

Pest description and damage This is a new pest in western Washington and possibly elsewhere. It was noticed in the spring of 2009 in Everett, Lynnwood, and Monroe areas, so it is likely to have arrived earlier. Typical of many sawflies, small gregarious larvae hatch from eggs in early spring and begin feeding in groups. Larvae are at first greenish with black dots down the side and a black head and legs. Before they pupate, the head and body turn orange with black spots. Initially, the larvae consume only soft leaf tissue leaving a fine network of leaf veins, but as larvae mature, larger veins are consumed along with the other leafy tissue. Finally, only the petiole, midrib, and the bases of a few secondary veins remain. Known hosts include the European and American mountain ash (*Sorbus aucuparia* and *S. americana*). Sawfly larvae are caterpillars with 5-7 prolegs (soft fleshy gripping hind legs) while moth larvae have five or fewer prolegs. Moth larvae also have little crochets on their prolegs while sawfly larvae do not. This is important because *Bacillus thuringiensis* is effective on moth and butterfly caterpillars, but not on sawfly caterpillars. A characteristic of sawflies is to feed in groups along a leaf edge with their hind end curled upward. The adult is a black wasp from 0.2 to 0.4 inch in length.

Biology and life history Adult sawflies emerge from the cocoons overwintering in the soil and leaf litter. Females cut slits in the marginal leaf surfaces and insert eggs in blister-like "pockets" in the leaf tissue. Larvae emerge and feed gregariously. By three to four weeks, the larvae mature and drop to the ground to spin their cocoons. In Monroe, Washington, adults emerged in August and a second generation of larvae began to feed immediately suggesting a third generation.

Pest monitoring Sawflies that are new to an area tend to build up large numbers and can cause significant defoliation. Early detection by watching as the new growth in the lower canopy develops is important because sawflies typically eat continuously and then drop out of sight (to pupate in the soil). Damage appears to occur overnight. Control of the first generation will reduce the number and severity of defoliation by the second and third generations.

Management—cultural control

Prune out infested branches, though that seems more radical than allowing defoliation to occur with branches releafing. Often the first generation of larvae that emerge in the spring concentrate their feeding damage on the lower branches, while later generations feed on the higher branches.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Sawfly" in:
Common Landscape Pests

Rosetta, R. 2009. Mountain ash sawfly. OSU Nursery IPM (https://agsci.oregonstate.edu/nurspest/insects/mountain-ash-sawfly)

Mountain ash (*Sorbus*)—Pear sawfly (pear slug)

California pear sawfly (*Pristiphora abbreviata*)
Pear slug (*Caliroa cerasi*)

Pest description and damage Pear slug is a European insect now found in most areas of the U.S. It attacks both pear and cherry and is found on mountain ash, hawthorn, and ornamental *Prunus*. The adult is a glossy black fly-like insect, about 0.2 inch in length. The larva initially resembles a

small tadpole due to the olive-green slime that covers the body, and the head being wider than the rest of the body. Mature larvae are 0.375 inch long and orange yellow. Larvae feed on the upper surface of leaves, skeletonizing them. Heavy feeding causes leaf drop, with reduction in vigor and yield, particularly on young trees. The pear sawfly is green in color, caterpillar-like, feeds along the leaf edges, and may be difficult to detect.

For biology, life history, monitoring and management

See:

Pear (*Pyrus*)—Pear sawfly (pear slug)

See "Sawfly" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Mountain ash (*Sorbus*)—Root weevil

Various species

Pest description and damage Identification is important as multiple species differ in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size. Larvae are rarely a significant problem in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Mountain ash (*Sorbus*)—Tent caterpillar

Forest tent caterpillar (*Malacosoma disstria*)
Western tent caterpillar (*Malacosoma californica*)

Pest description and damage The western tent caterpillar attacks a wide variety of plants including alder, ash, birch, cottonwood, and willow, as well as fruit trees and roses. The over 1-inch-long adult moths are attracted to lights at night. Mature western tent caterpillars can reach a length of about 2 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.625 inch long, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

For biology, life history, monitoring and management

See:

Alder (*Alnus*)—Tent caterpillar

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Narcissus (*Narcissus*)—Narcissus bulb fly

Narcissus bulb fly (*Merodon equestris*)

Pest description and damage The larva is a fat, yellowish-white, and wrinkled maggot and 0.75 inch in length. The lesser bulb fly adults are blackish green with white markings on the abdomen; the larvae are smaller and more numerous in the bulbs. The maggots of the narcissus bulb fly burrow into the bulbs near the basal plate and feed inside the bulbs, destroying bulb scale and flower parts while maggots of the lesser bulb fly are thought to be scavengers. Infested bulbs may develop spindly, grassy-looking leaves if the bulb is not badly damaged. Severely damaged bulbs are soft, brown, and decayed. The narcissus bulb fly attacks amaryllis, *Galtonia*, hyacinth, iris, lily, *Leucojum, Narcissus, Scilla*, tulip, and *Vallota*. The

lesser bulb fly also attacks and may be a primary pest on onions and shallots and other bulbs.

For biology, life history, monitoring and management

See:

Daffodil (*Narcissus*)—Narcissus bulb fly

Oak (*Quercus*)—Carpenterworm

Prionoxystus robiniae

Pest description and damage Carpenterworms are the larvae of a large, mottled gray and black moth (goat moth). The caterpillars are white to pinkish red with a dark head and are 1 to 3 inches in length when mature. The caterpillars bore in the trunk and main branches. Discolored or bleeding limbs, branch dieback, and lumpy or gnarled trunks may be indications of carpenterworm infestation. Trees with severe carpenterworm infestations are susceptible to wind breakage and may need to be removed to reduce safety concerns. Infestations may kill trees eventually.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Carpenterworm

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Oak (*Quercus*)—Oak gall wasp

Includes
Oak twig gall wasp (*Bassettia ligni*)
California jumping gall wasp (*Neuroterus saltatorius*)
Speckled gall wasp (*Cynips mirabilis*)
California gall wasp (*Andricus quercuscalifornicus*)

Pest description and damage Over 400 galls have been identified on oak. The feeding of several species of oak gall wasp larvae causes these leaf galls. Typical galls are enlarged or swollen plant tissues. These may assume several forms, depending on the species of wasp. The main gall wasp on Oregon white oak includes Andricus quercuscalifornicus, which forms large (up to 4 to 5 inches in diameter), persistent, apple-like galls on twigs. Another species, Bassettia ligni, causes seed-like galls under the bark of branches that often girdle and kill the branch. Cynips mirabilis forms mottled, spherical galls up to 1 inch in diameter on the underside of leaves, and Neuroterus saltatorius forms mustard-seed-like galls (roughly 0.04 inch in diameter) on lower leaf surfaces that drop in the fall and jump around like Mexican jumping beans (caused by activity of the enclosed larvae).

The California gall wasp causes the largest and most conspicuous of the galls on oak, achieving a diameter of 1 to 4 inches or more. This twig gall is often called an oak apple. It starts out green and in time becomes red on the sunny side. Later in the season, the gall turns brown or greyish just before the adult wasps chew their way out. The gall does no apparent damage to the tree and is removed easily without harming the twig. During its development, the gall may host up to a dozen larvae.

Jumping oak galls cause small yellow spots on the upper surface of infested leaves. On the underside of the leaves are tiny seed like galls. These appear in midsummer or later. Inside each gall is the larvae of a tiny wasp. In the fall, the galls drop from the leaves to the ground, where the activity of the larva causes the gall to jump an inch or more off the ground. The wasps overwinter in the galls on the ground. In the spring, emerging females lay eggs in opening oak buds. Adult females emerging from these galls lay eggs on the leaves, producing the larvae that cause the jumping oak galls. Although they may be unsightly, jumping oak galls do relatively little damage.

Stem galls, like those caused by the oak twig gall wasp, are caused by the feeding of any of several species of oak gall wasp larvae. Typical galls are enlarged or swollen. Galls associated with oak stems are often smooth and round but may be elongated, thorny, or rough. They can be single galls or clusters of galls. Colors vary from green to reddish to brown, depending on the wasp species causing the gall and the age of the gall.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

For more information

See "Gallmakers" in:

Common Landscape Pests

Oak (*Quercus*)—Oak leaf phylloxera

Phylloxera spp.

Pest description and damage Phylloxerids are very small (0.01 to 0.02 inch) aphid-like insects that lack cornicles. They are usually spiny in appearance and found in clusters. Winged forms have reduced wing venation. They attack the foliage and buds of red and white oak trees of all sizes. Buds and young developing leaves (undersurface) on terminals and branch ends are attacked, causing bright yellow spots and leaf distortion.

Pest monitoring Early detection on foliage will allow time to decide if management options will be useful.

Management—biological control

Natural controls usually keep damage to a minimum. There are ten species of predators recorded as feeding on oak phylloxera. Nevertheless, at times significant damage and defoliation may occur.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Oak (*Quercus*)—Oak skeletonizer

Oak skeletonizer (*Bucculatrix ainsliella*)
Oak-ribbed skeletonizer (*Bucculatrix albertiella*)

Pest description and damage This insect also is known as the oak ribbed casemaker (*Bucculatrix albertiella*). The adult moth is mottled white, brown, and black with a wingspread of about 0.33 inch. The mature larvae are pale yellow to green and about 0.25 inch in length. Young larvae feed inside leaves, chewing away tissues and leaving a linear mine. Older larvae feed on the underside of leaves, leaving only the upper surface and veins, which turn brown. Severely damaged leaves may be almost transparent. The oak ribbed casemaker is reported on California white (valley) oak (*Quercus lobata*) and coast live oak (*Q. agrifolia*).

Biology and life history This insect appears to pass the winter inside its characteristic cocoon. Immature larvae make flat, white, circular hibernating cocoons, while cocoons of mature larvae are oblong and white with distinctive longitudinal ribs. The latter are found on leaves, twigs, or other nearby underlying objects. It is easy to transport this insect stage from place to place with infested plant material. The moths appear in spring and lay eggs on the undersides of leaves. The larvae emerge and feed on the foliage. There are two generations per year.

Management—biological control

Natural enemies probably help keep populations in check. Avoid use of broad-spectrum insecticides that kill beneficial insects.

Management—cultural control

Rake up fallen leaves to remove cocoons; destroy by deep composting.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Oak (*Quercus*)—Pit scale

Asterolecaniidae including Golden oak scale (*Asterodiaspis variolosa*)

Description, biology and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Adult pit scale insects are covered with a hard scale and are about 0.06 inch in diameter. They may be brown, gold, or greenish. They feed on twigs and small branches, with young wood most infested. Pit scale feeding causes the tissue of the twig to swell around the insect, so the scale only appears to be in a pit on the bark. Numerous scales on a twig cause it to appear roughened. Severe infestations cause twig dieback. Heavy infestations of pit scales combined with drought stress or anthracnose (a fungal disease) can result in severe weakening or death of trees.

For biology, life history, monitoring and management

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Oak (*Quercus*)—Rose leafhopper

Includes *Edwardsiana rosae*

Pest description and damage Rose leafhoppers are small (0.14 to 0.16 inch in length), active, whitish-green insects which run backwards, forwards or sideways when disturbed. The nymphs (immature) are white with red eyes. Rose leafhoppers feed on the leaves, causing white or pale blotches that resemble, but are larger than, spider mite stippling. Injured leaves may drop prematurely. The egg-laying in the fall also wounds the canes, providing entry points for fungal pathogens. Cast skins are found on the underside of leaves. Leafhopper damage is mainly aesthetic.

For biology, life history, monitoring and management

See:

Rose (*Rosa*)—Rose leafhopper

See "Leafhopper" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Oak (*Quercus*)—Western oak looper

Lambdina fiscellaria

Pest description and damage The adult moth has about 0.7-inch wingspan and is yellowish to dark brown. Mature larvae of the western oak looper are about 1 inch long and light brown with black spots when mature. They move in a characteristic "looping," inchworm fashion. The western oak looper feeds mainly on the foliage of the Oregon white (or Garry) oak (*Quercus garryana*). It is probably the most damaging insect on white oak from Oregon north to British Columbia. In some years, oaks over large areas in the Willamette Valley are defoliated. The damage is temporary, since the trees leaf out the next year, and outbreaks are not sustained.

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Peach, flowering (*Prunus*)—Aphid

Includes green peach aphid (*Myzus persicae*)

Pest description and damage Several species of aphids may feed on the foliar, stem, flower, bud, bark or root tissues of many trees and shrubs. Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies with aphid species, but green peach aphid is green. Aphids feed in colonies and are found on the most succulent plant tissues. Feeding damage to plants is usually minor but can compromise the vigor of the host. When aphid populations are high, leaf and shoot distortion can occur. Aphids produce honeydew, a sweet, sticky secretion that collects on underlying plant tissues and encourages growth of a black sooty mold. In addition to cosmetics, honeydew may become a sticky nuisance when it falls on decks, cars, or other landscape surfaces. Some aphids are vectors of plant diseases, particularly viruses.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Peach, flowering (*Prunus*)—Cherry bark tortrix

Enarmonia formosana

Pest description and damage Cherry bark tortrix is a pest of most woody ornamental trees and shrubs in the family Rosaceae. The larvae are 0.33 to 0.4 inch in length, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a yellowish-brown head. Larvae feed directly on the cambium under tree bark and may cause death of the tree in sufficient numbers. Otherwise, the feeding activity decreases the supply of nutrients to the tree and increases susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the exuding of reddish-brown, gum-like resin, which often is mixed with fecal pellets and silk. The trunk and larger limbs of bearing fruit trees are affected usually at pruning wounds and graft unions. The adult moth has a wingspan of about 0.33 inch and is a mottled yellow, cream and brown in appearance.

For biology, life history, monitoring and management

See:

Cherry (*Malus*)—Cherry bark tortrix

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Peach, flowering (*Prunus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inch in length, covered with yellow to rusty- to black-colored silky hairs. Adult moths have a 1-inch wingspan and are bright white with orange and black markings on the underside of their abdomens. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood *(Populus*)—Fall webworm

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Peach, flowering (*Prunus*)—Leafrollers

Includes
European leafroller (*Archips rosana*)
Fruit tree leafroller (*Archips argyrospila*)
Oblique banded leafroller (*Choristoneura rosaceana*)

Pest description and damage For the most part, the term, "leafrollers" refers to the larvae of moth species. They all cause similar damage but differ in their appearance and, more importantly, in their life cycle. The leafroller pests are divided into single-generation moths, such as the fruit tree leafroller and the European leafroller, and two-generation moths, such as the oblique-banded leafroller and pandemis leafroller. The larvae are mostly green caterpillars with a light brown to black head. Mature larvae range from 0.75 to 1.0 inch in length. Adults have distinctive bands or mottling on the wings. The tortricid moth larvae are noted for their violent backward wriggling—a means of escape. Newly hatched larvae also may work into blossoms and damage developing fruit, which then abort and fall off the tree. The larvae web the leaves and flowers together beginning in late April, and then feed on the developing fruit or flowers. Adult moths have a wingspan of 0.75 inch.

For biology, life history, monitoring and management

See:

Cherry, flowering (*Prunus*)—Oblique-banded leafroller

See "Leafroller and leaftier" in:

Common Landscape Pests

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Peach, flowering (*Prunus*)—Peach silver mite

Aculus fockeui

Pest description and damage Peach silver mites are tiny (about 0.006 inch in length), four-legged eriophyid mites, yellow to pinkish white, and somewhat wedge-shaped. On rare occasions when very high populations of peach silver mite survive the winter, they produce symptoms on the unfolding leaves. Symptoms consist of minute, yellow spots, and a tendency for the leaf edges to curl toward the midrib. Ordinarily, however, most injury is not noticed until mid- to late summer, when heavily infested leaves take on a silvery appearance.

Biology and life history The mites overwinter as females in bark crevices, around buds, and under bud scale. They move to the leaves soon after budbreak in spring. Later in the season, they are primarily on the lower leaf surface. Before leaf fall, females move to overwintering sites on the tree. Many generations are produced during the season.

Management—biological control

Treatments applied specifically for control of peach silver mites rarely are needed and should be avoided, because peach silver mites serve as early season food for predaceous mites, which in turn reduces populations of other pest mites.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Peach, flowering (*Prunus*)—Peachtree borer

Synanthedon exitiosa

Biology and life history The borer overwinters as a larva on or under the tree bark, usually below ground. As temperatures rise above 50°F in the spring, the larva resumes feeding on the tissues under the bark. At maturity in May and June, the larva pupates. Adult moths emerge beginning in June and continue through September. The adult is a metallic blue-black, clearwing moth. The male moth with a 1-inch wingspan may have bands of light-yellow scales on the abdomen, which makes it resemble a wasp. The female has a 1.25-inch wingspan and an orange band around the abdomen. Eggs are laid quickly after mating. Young larvae hatch after eight to ten days and bore immediately into the base of the tree. Larvae in the bark above the soil line usually do not survive the winter in cold areas.

Pest monitoring Monitor for flying clearwing moths by using pheromone traps starting in mid-June or watch for gummy frass at base of trees. This insect can do substantial damage if not controlled. Feeding damage made by one larva can kill a small tree.

Management—biorational control

Pheromone mating disruption (Isomate P) at 100-250 dispensers/A. Dispensers are placed in trees before first moth flight. Moth flight is usually from late June through September. If mating disruption is used, monitor blocks with traps baited with peachtree borer lures at one trap/2.5 A. If two or more moths are caught, a conventional insecticide application may be required.

Management—cultural control

Place a light metal or flexible plastic cone around the base of the tree before egg laying begins to protect it from larval entry. The cone is pushed 1 to 2 inches into the soil and should fit snugly around the trunk at the top to prevent the tiny larvae from getting beneath it. Budding tape or other flexible material helps seal the top. Alternatively, if only one or a few peach trees are involved in a home orchard, it is quicker and cheaper to control this insect by direct removal: use a pocketknife or some pointed instrument to remove dirt around the tree and dig out the larvae.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Peach, flowering (*Prunus*)—Peach twig borer

Anarsia lineatella

Pest description and damage Peach twig borer is a European insect first found in California in the 1880s. It is a major pest of apricots, peaches, plums, and prunes. There are no native hosts outside the orchard. The adult is a steel-gray moth with white and dark scales, and a wingspan of about 0.33 to 0.5 inch. The larva is a caterpillar, approximately 0.5 inch in length, with a dark brown head and distinctive, alternating light and dark bands on the body. The pupa is smooth and brown. The larva of the borer causes injury to fruit and trees. Feeding on the buds and twigs occurs early in the season, after which the larva bores into the shoots, causing a characteristic “flagging” or wilting of the new growth. Later generations of larvae feed in shoots or fruit, disfiguring the fruit.

Biology and life history The borer overwinters as an immature larva in tunnels constructed in the crotches of twigs and branches. These overwintering sites are identified by the small chimneys of frass and wood chips produced by the feeding of the larvae. Larvae become active at the pink bud stage and emerge to feed on buds and young leaves before boring into a shoot. These larvae eventually leave the mined shoot to pupate. Adults emerge in mid- to late May. Eggs are laid on fruit, shoots, or undersides of leaves. Eggs are yellowish white to orange. The eggs hatch, and these larvae feed and mature on shoots and immature fruit. The next adult flight is in mid-July. Part of the larvae from this flight overwinter, the rest produce a partial third flight.

Pest monitoring Check for overwintering sites on small trees. Otherwise, examine shoots in late April or early May. Wilted shoots are easy to spot, and you should open them to check for larvae.

Management—biological control

A tiny parasitic wasp that parasitizes eggs is active in orchards at shuck fall.

Management—cultural control

Cut out mined shoots below the wilted area to eliminate larvae. Overwintering larvae are found under thin bark in branch axils and destroyed. Look for a buildup of chewed bark and frass.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Peach, flowering (*Prunus*)—Spider mite

Tetranychus spp.

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen, and coniferous ornamentals. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Twospotted mites are oval and yellowish-

brown or green with distinctive black spots on the body. Plants is covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites damage leaves and fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Pear, flowering (*Pyrus*)—Aphid

Includes green peach aphid (*Myzus persicae*)

Pest description and damage Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies but most aphids tend to match host plant coloration. Aphids tend to feed in colonies and are found on the most succulent plant tissues. Feeding damage to trees is usually minor, but if heavy can compromise the vigor of the host. Aphids produce honeydew that supports the growth of a black sooty mold fungus. Some aphids are vectors of plant diseases, particularly viruses.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Pear, flowering (*Pyrus*)—Apple-and-thorn skeletonizer

Choreutis pariana

Pest description and damage Larvae are 0.5 inch in length, yellowish to greenish, with black spots and a yellow-brown head. Pupae are yellow to brown within a white silken cocoon. The larvae skeletonize and roll leaves from the tip or sides. Damaged leaves are brown and papery and drop prematurely. Adult moths are reddish brown, with a wingspread less than 0.5 inch, and irregular light and dark bands on the wings.

Damage varies from inconsequential to serious, so monitoring is an important management tool.

For biology, life history, monitoring and management

See:

Crabapple (*Malus*)—Apple-and-thorn skeletonizer

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Pear, flowering (*Pyrus*)—Cherry bark tortrix

Enarmonia formosana

Pest description and damage Cherry bark tortrix is a pest of most woody ornamental trees and shrubs in the family Rosaceae. The larvae are 0.33 to 0.4 inch in length, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a yellowish-brown head. Larvae feed directly on the cambial tissues of the tree and may cause death of the tree in sufficient numbers. Otherwise, the feeding activity decreases the supply of nutrients to the tree and increases susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the exuding of reddish-brown, gum-like resin, which is mixed with fecal pellets and silk. The trunk and larger limbs of bearing fruit trees are affected, usually at pruning wounds. The adult moth has a wingspan of about 0.33 inch and is a mottled yellow, cream and brown in appearance.

For biology, life history, monitoring and management

See:

Cherry (*Malus*)—Cherry bark tortrix

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Pear, flowering (*Pyrus*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature oystershell scale insect is approximately 0.125 inch in length under a pinkish brown or gray scale that is usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs of many broad-leaved deciduous plants. They occur less frequently on the leaves and other plant parts such as the fruit. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Newly emerged crawlers look like bright white pimples on the bark.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Oystershell scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Pear, flowering (*Pyrus*)—Pearleaf blister mite

Eriophyes (*Phytoptus*) pyri

Pest description and damage Adults of the pearleaf blister mite are very tiny (about 0.009 inch in length) and can be seen only under magnification. These mites are light to amber yellow, cylindrical, tapered at the posterior end, with two pairs of short legs at the front of the body. The overall appearance is that of a small worm. Nymphs are similar in appearance to adults but smaller. Pearleaf blister mite feeding on leaves causes reddish to yellowish-green blisters; blisters turn brown or black as the tissue dies later in the season. Leaves may drop prematurely. Loss of foliage weakens trees and reduces shoot growth and flowering.

Biology and life history Blister mites overwinter as mature females under outer bud scales. As buds swell in the spring, the mites burrow inside to feed. As leaves unfurl, blisters are already evident. At petal fall, they move to more leaves or fruit, causing characteristic blisters. Several generations per year may develop within the blisters. As they become more crowded, mites move to growing terminals, where their feeding produces more blisters. Mites move from tree to tree by wind or carried on birds or insects.

Pest monitoring Scouting for pearleaf blister mite is not effective during the current season. By the time blisters are noticed, the mites are safely inside, and the damage is done. Plan to take action the following fall or winter if damage is noted. Sufficient control is achieved by midsummer by biological agents.

Management—biological control

Phytoseiid predator mites almost always keep mites under control if broad-spectrum insecticide applications are avoided. Heavy rain and cold weather also suppress mite numbers.

Management—cultural control

Suppression of broadleaf weeds such as mallow, bindweed, white clover, and knotweed with cultivation or grasses may reduce mite numbers. Wash mites from the tree with a strong stream of water. Water trees properly, as drought-stressed trees are more susceptible. Avoid excessive nitrogen applications, as this encourages mites.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Pear, flowering (*Pyrus*)—Pear sawfly (pear slug)

California pear sawfly (*Pristiphora abbreviata*)
Pear slug (*Caliroa cerasi*)

Pest description and damage Pear slug is a European insect now found in most areas of the U.S. It attacks both pear and cherry and is found on mountain ash, hawthorn, and ornamental *Prunus*. The adult is a glossy black fly-like insect, about 0.2 inch in length. The larva initially resembles a small tadpole due to the olive-green slime that covers the body, and the head being wider than the rest of the body. Mature larvae are 0.375 inch in length and orange yellow. Larvae feed on the upper surface of leaves, skeletonizing them. Heavy feeding causes leaf drop, reduction in vigor and yield, particularly on young trees. California pear sawfly is found occasionally defoliating pear trees. Larvae eat round holes in leaf, with extensive feeding only the midrib will remain. The larvae are bright green, closely matching the leaf color, and feed along the edges of leaves. A minor pest in orchards, it can severely defoliate ornamental pears.

Biology and life history Pear slug overwinters as a pupa in a cocoon two to three inches deep in the soil. Adults emerge over an extended period in late April–May. The adult female inserts eggs into leaf tissue, and eggs hatch in 10 to 15 days. Larvae immediately begin to feed on the upper surface

of the leaf. After three to four weeks, they drop to the soil to pupate. Second generation adults emerge in July and larvae from this generation feed in August and September. Most larvae from this generation drop to the ground to overwinter.

Pest monitoring Watch trees for the slug-like larvae or skeletonized leaves in early spring to indicate potential for defoliation by subsequent generations, and again in August and September when large populations can build up. Watch for the caterpillar-like bright green sawflies on pear or telltale leaf skeletons consisting of only midrib and main veins caused by California pear sawfly.

Management—biological control

Specific biocontrol agents are not known, but this is rarely a pest in backyard gardens, so significant biocontrol likely occurs most years.

Management—cultural control

Pick off or squash individual larvae or wash them off with a strong stream of water. Old records recommended fine road dust (or other fine powder to stick to the slimy surface and suffocate the pear slug larvae.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Sawfly" in:
Common Landscape Pests

Anon. 2008. California pear sawfly (http://www.ucipm.ucdavis.edu/PMG/r603301811.html)

Pear, flowering (*Pyrus*)—San Jose scale

Quadraspidiotus perniciosus

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The San Jose scale is found on fruit trees and many ornamentals throughout the U.S., particularly in hot, dry climates. San Jose scale can be differentiated from other scale insects by the scale (shell) that covers the adult females. The San Jose scale is about 0.06 inch in diameter, and hard, gray to black, and cone shaped. The scale has a tiny white knob in the center with a series of grooves or rings around it. Twigs with infested bark are roughened, rather than smooth, and twig death may occur. Often there is a purple halo on the bark around the scale. At high population densities, fruit is infested. Crawlers are flat, yellow, and common in June and again in August to September.

For biology, life history, monitoring and management

See:
Cherry, flowering (*Prunus*)—San Jose scale

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Pear, flowering (*Pyrus*)—Tent caterpillar

Forest tent caterpillar (*Malacosoma disstria*)
Western tent caterpillar (*Malacosoma californica*)

Pest description and damage The western tent caterpillar attacks a wide variety of plants, including alder, ash, birch, cottonwood, and willow—as well as fruit trees and roses. The over 1-inch-long adult moths are attracted to lights at night. Mature western tent caterpillars can reach a length of about 2 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.625 inch in length, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

For biology, life history, monitoring and management

See:
Alder (*Alnus*)—Tent caterpillar

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Photinia (*Photinia*)—Aphid

Includes melon aphid (*Aphis gossypii*) and others

Pest description and damage Several species of aphids may feed on the foliar, stem, flower, bud, bark or root tissues of broadleaf trees, shrubs. Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Color varies but most aphids tend to match host plant coloration. Aphids feed in colonies and are found on the new or most succulent plant tissues. Feeding damage to shrubs is usually minor but can compromise the vigor of the host. When aphid populations are high, leaf and shoot distortion can occur. Aphids produce honeydew, a sweet, sticky secretion that collects on underlying plant tissues and encourages growth of a black sooty mold. Some aphids are vectors of plant diseases, particularly viruses.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Photinia (*Photinia*)—Cherry bark tortrix

Enarmonia formosana

Pest description and damage Cherry bark tortrix is a pest of most woody ornamental trees and shrubs in the family Rosaceae. The mature larvae are 0.33 to 0.4 inch long, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a yellowish-brown head. Larvae feed directly on the cambial tissues of the tree and may cause death of the tree in sufficient numbers. Otherwise, the feeding activity decreases the supply of nutrients to the tree and increases susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the exuding of reddish-brown, gum-like resin, which often is mixed with fecal pellets and silk. The trunk and larger limbs of bearing fruit trees are affected, usually at pruning wounds and graft unions. The adult moth has a wingspan of about 0.33 inch and is a mottled yellow, cream and brown in appearance.

For biology, life history, monitoring and management

See:

Cherry (*Malus*)—Cherry bark tortrix

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Photinia (*Photinia*)—Root weevil

Numerous species

Pest description and damage Species identification is important as root weevil species differ in susceptibility to pesticides and can have different life cycles. Adult weevils are dark colored, nocturnal beetles, from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Larvae are rarely a problem in landscapes. Look for ragged notches on the edges of leaves, or flower petals or dead tips of plants where weevils have girdled the twig.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Photinia (*Photinia*)—Scale insect

Lecanium scale (*Parentholecanium* spp.)
Oystershell scale (*Lepidosaphes ulmi*)
San Jose scale (*Quadraspidiotus perniciosus*)

Description, biology and management Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Lecanium scale

Ash (*Fraxinus*)—Oystershell scale

Cherry, flowering (*Prunus*)—San Jose scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Pine (*Pinus*)—Black pineleaf scale

Dynaspidiotus (*Nuculaspis*) *californica*

Description, biology and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Mature black pineleaf scales are almost circular, 0.06 inch in diameter, and yellowish brown to black. Young hatch in spring and summer. Scale feeding is restricted to the needles and the needles become splotched with yellow patches. Heavy infestations cause premature needle drop and may result in death of the tree. Affected trees often display a thin crown, yellow or reddish coloration, and a shortening of the needles.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Pine (*Pinus*)—Coneworm and shoot moth

Dioryctria spp.

Pest description and damage Adult coneworms are mottled gray or brown snout moths banded with subtle waves of color and about 0.6 to 0.7 inch in length. The coneworm larvae are small and cream-colored or light brown with a darker head. Coneworms attack true firs by boring into shoot tips or stems, especially around wounds, and feeding on the soft bark tissues. The portion of the branch beyond the injured point may die back. Coneworms also may bore into green cones, feed on the soft bark of young growth, or feed inside the bark on the trunk cambium. There are many species of *Dioryctria* that feed on multiple tissues of small plants including trunk shoots and cones.

For biology, life history, monitoring and management

See:

Douglas-fir (*Pseudotsuga*)—Coneworm

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Pine (*Pinus*)—Eriophyid mite

Trisetacus spp.

Pest description and damage Eriophyid mites are tiny (around 0.007 inch in length), elongated, whitish or tan mites that feed under bud scales or in the needle sheaths, often down in the fascicles at the needle base. Two types of symptoms of eriophyid mite feeding are browning of the newly emerging shoots and yellowing, twisting, distortion, and stunting of needles. Occasionally there is development of numerous buds where a single bud has been infested (rosetting). Severe infestations may kill needles and cause needle drop, leaving naked branch tips. Rosettes may develop into

witches' broom growths. Two-needle pines, particularly lodgepole or shore pine, are affected.

Biology and life cycle Little is known about these pests. They presumably overwinter as eggs deep in the needle fascicles and hatch in spring as new growth begins.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—European pine shoot moth

Rhyacionia buoliana

Pest description and damage Adult moths are about 0.4 inch in length and reddish orange with silver markings on the wings. The mature larvae are about 0.63 inch in length and reddish-brown with black heads. The larvae of the European pine shoot moth feed on the terminal buds. They first bore into needles or base of the bud. Next, the larva bores partially into the buds and weaves a small web between the two, and seals it with pitch. Eventually the infested buds are covered with what appears to be a glop of pitch, but it is hollow. As the bud develops, the injured side cannot grow, so the non-injured side grows faster, and elongating shoots develop a characteristic "shepherd's crook." The larvae will bore down into the shoot at the base of the elongating shoot that then turns brown. All pines are susceptible, especially two- and three-needle species. This pest is of cosmetic concern to pine tree exporters and landscape plants. This insect is also under quarantine in some areas and that increases costs to ship greens or Christmas trees to non-infested areas.

Biology and life history This insect overwinters as larvae in the mined buds, covered with resin-coated webs. Each larva may infest several buds throughout its growth. In spring, the adult moths emerge and lay eggs on needles near leaf bases in the late spring. The larvae hatch and mine the needle, which then turns yellow or brown. By midsummer, the larvae switch to buds and mine both buds and shoots below the bud. They spend winter protected inside the infested bud or shoot and emerge the following spring in about June. Evidence of emergence is the brown pupa protruding from the bud. There is one generation per year.

Pest monitoring Check for brown buds and yellowed leaves at shoot tips in midsummer. Pheromone lures and traps and degree-day models are available to monitor for adult flight. Successful management depends on applications that coincide with adult moth flight or when larvae change buds in fall. Check Oregon State University On-Line Phenology and Degree-day Models (http://ippc2.orst.edu/cgi-bin/ddmodel.pl?spp=eps).

Management—cultural control

On small landscape trees or shrubs, prune out infested (brown) buds and candles while the larvae are still inside. Be sure to prune far enough below the buds to remove the insects and destroy the trimmings.

Management—biological control

When European pine shoot moth first arrived in Washington, pines were severely infested for a few years. However, some years after this pest became established, parasitoid wasps began to emerge from infested shoots instead of moths. Populations have leveled off, so that only brief isolated infestations now occur.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Pine (*Pinus*)—Mountain pine beetle

Dendroctonus ponderosae

Pest description and damage Adults are black and about 0.25 inch in length. Larvae are white and found under the bark in straight galleries. The mountain pine beetle attacks pine trees (trunks and branches) 4 or 5 inches in diameter or larger. The adults and larvae mine the bark, weakening and girdling trees. Heavily infested trees may decline or die. Red sawdust on the bark and ground and pitching on the trunk or large branches may indicate the presence of these bark beetles. Bark beetles typically attack weakened trees. Lodgepole pine is the preferred host, but other pines are attacked. This insect is among the most destructive of the bark beetles.

Biology and life history The insects overwinter as larvae or adults under the bark of the host tree. In the spring, adults emerge, fly to new host trees and excavate galleries under the bark. Eggs are deposited singly along the gallery on alternate sides. When the eggs hatch in a few days, the small white larvae excavate short feeding tunnels at right angles to the gallery. When fully grown, the larvae construct small pupal cells at the ends of the larval mines and then emerge as adults the next spring. One generation per year is the general rule.

Pest monitoring Look for pitch tubes and red boring dust in bark crevices and on the ground.

Management—cultural control

Healthy trees are better able to resist borer infestations, so use proper watering, fertilizing, and pruning practices. Remove heavily infested trees to

protect healthy adjacent ones.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—Pandora moth

Coloradia pandora

Pest description and damage The adult is a large (2.7-to-4-inch wingspan), brown-gray, heavy-bodied moth with black markings on the wings. Pandora moth larvae are brownish- to yellowish-green, spiny, and about 1 inch long at maturity. The larvae feed on the needles of pines, especially ponderosa, Jeffrey, and lodgepole. The stubs of eaten needles remain on the twigs, and the crowns of infested trees often are thinned. The larvae may cause severe defoliation when there are large outbreaks. They travel in single file when moving to new feeding areas. This is a sporadic pest of forest and landscape trees.

Biology and life history The adult moths emerge in midsummer and lay eggs on pine needles or bark. The larvae emerge and feed on new foliage throughout the summer. They overwinter on the tree in clusters then resume feeding in spring. They drop to the soil to pupate. Pupation lasts for at least one year. Control is not needed except in outbreak years.

Pest monitoring Be alert for signs that the population is growing based on increased tree defoliation or clusters of larvae in the winter.

Management—cultural control

Prune out severely defoliated sections of the tree. Pick larvae by hand if found. These larvae are considered a delicacy among the tribes in areas where they are found.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Pine (*Pinus*)—Giant conifer aphid

Cinara spp.

Pest description and damage *Cinera* species are generally large (0.13 to 0.2 inch in length) aphids. These soft-bodied insects have piercing–sucking mouthparts. Many of the pine aphids tend to be waxy and feed in colonies. They are found on the bark or underside of branches and twigs or among needles. Feeding damage to mature plants is usually minor, but it can compromise the vigor of small trees. Often the first indication that aphids are present is the large number of yellowjacket wasps that are foraging among the foliage for honeydew. Some of the branches may appear flocked with white waxy material. Infestations are often sudden, but brief.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—Pine bark adelgid

Pineus strobi

Pest description and damage This adelgid feeds on the bark of pines and spruce. They are about 0.03 inch in length and appear woolly and may be confused with woolly aphid species. Pine bark adelgids form woolly or cottony white masses on the trunk, branches, or twigs. The adelgids are black and short-legged under the white material. Heavy infestations can look like snow on the trunks of trees. Seedling and young trees may have adelgids at the base of the needles or on shoots instead of on the trunks. Needles often become somewhat yellowish (chlorotic). Severe adelgid infestations can result in stunting or death of trees.

Biology and life history The insect overwinters in an immature state on the tree. As the weather warms, they secrete waxy material over their bodies in woolly tufts. Small clusters of eggs are laid in the tufts in early spring. Crawlers emerge and move to other parts of the tree or are blown or carried to other hosts.

Pest monitoring Begin observing shoots prior to budbreak, looking for white cottony insects on the bark of the trunk or undersides of branches. Confirm by checking leaves. Check for presence of natural enemies.

Management—biological control

Encourage natural predators including lady beetles and lacewings. Check colonies to determine if there are live adelgids or crawlers.

Management—cultural control

Hand-wipe or use a stiff brush to control small infestations where possible. Wash adelgids from trunks and foliage with a strong stream of water. Where practical, remove and destroy heavily infested branches and trees.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—Pine white butterfly

Neophasia menapia

Pest description and damage Adult pine butterflies have a wingspan of 1.75 to 2 inches and are white with black markings and closely resemble the cabbage butterfly; females have a yellow cast to the forewings. Females lay emerald green eggs along needles tilted at a 45° angle. The larva of the pine butterfly is a dark green caterpillar with white stripes on the sides and a black head. The caterpillars feed gregariously on the needles: young larvae feed in clusters on the older needles, while older larvae feed in smaller groups or singly. They cause relatively little damage except in years of severe outbreaks. They feed high in the canopy so damage, unless severe, is rarely noticed. Their preferred host tree is ponderosa pine, but they are common in western white pine. Adults are also commonly seen flying around Douglas-fir. In Eastern Washington, the larvae of this butterfly have caused significant defoliation in pine forests.

Biology and life history The insect overwinters as eggs on pine needles in the upper canopy. In the late spring, the larvae emerge and begin to feed on the new needles as they begin to appear. They pupate in a chrysalis suspended by silk in the tree or underlying vegetation. In mid- to late summer, the adults fly and females lay their eggs.

Management—cultural

Because of their preference for treetops, cultural controls in landscape settings are not practical. On small trees, larvae are picked off and destroyed.

Management—biological

Butterflies are kept to low numbers by the many parasites specializing in Lepidoptera. Presumably, crown-feeding birds also would feed on them.

For biology, life history, monitoring and management

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—Pine needle scale

Chionaspis pinifoliae

Pest description and damage Pine needle scale insects are about 0.1 inch in length. Female adults appear as elongate white scales that are found on and feed on the needles. The insects beneath the scales are reddish orange, or the scale is filled with rusty colored eggs. Heavily infested trees may appear crusted with white. Infested needles turn yellow, then brown. Twigs and branches may be killed. Repeated infestations may kill trees eventually. Pine needle scales often are found with black pine leaf scales, which are gray to black instead of white. Pine needle scales also infest ornamental pines, arborvitae, cedar, hemlock, spruce, and Douglas-fir.

Biology and life history The insect overwinters as eggs beneath the female scale cover. The eggs hatch in May or June, and the reddish crawlers migrate to a new part of the host tree or are blown or carried to new hosts. One or two generations occur, depending on location. If there are two generations, second generation crawlers are found by midsummer.

Pest monitoring Check pines that appear yellowish or unthrifty. Look for white scales protected inside the curved interior of the needle bundles. Occasionally trees are visibly white with scales. Since scale insects do not fall off, check to be sure that the scales are still present under the scale-covering or that crawlers are on the foliage before initiating pesticide application.

Management—cultural control

Keep plants healthy with proper watering. Populations are reported to build more rapidly on stressed or dusty plants.

Management—biological control

Small numbers are easily tolerated and provide food for parasitoids that keep scale insects in check. Parasitoids, lady beetles, and birds feed on scales. Holes in scales are made by exiting parasitoids. The whitish residue on the needle indicates where a scale was eaten; both are evidence of natural enemies at work.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

See also "Scale insect" in:
Common Landscape Pests

Pine (*Pinus*)—Pine needle sheathminer

Zelleria haimbachi

Pest description and damage Adult pine needle sheathminers are silvery moths about 0.5 inch across. Young larvae are bright orange with a black head. Older larvae are tan-color and 0.5 inch long. Young larvae mine inside needles, while older larvae feed at the base of needles inside the needle sheath. Damaged needles often droop or stick out from the stem at a sharp angle. Pine sheath miners attack species and hybrids of two- and three-needle pines as well as western white pine; and seem to prefer smaller trees.

Biology and life history The insect overwinters as an immature larva within the needle sheath. In spring, feeding resumes and the larva pupates on the shoot tip. Adults lay eggs on needles from early to midsummer. There is one generation per year.

Pest monitoring Look beneath trees for clusters of needles bound together to form a tube, or on branches for needles bound together rather than fanned out.

Management—cultural control

On smaller trees, prune out and destroy heavily infested branch tips or needle clusters in early spring.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—Pine sawfly

Includes *Neodiprion nanulus*

Pest description and damage Larvae are yellow green with black heads and about 0.63 inch in length when fully grown. Female adults are about 0.38 inch in length and are yellow brown. Males are slightly smaller and mostly black. Larvae can strip all old needles from trees. New foliage is not eaten. Mortality and top kill can occur on large ponderosa pines after two years of heavy defoliation. Defoliation may be similar to that of pine butterfly. Larvae and adults are distinctly different, however.

Biology and life history Pine sawfly overwinters as eggs inside slits in pine needles. Eggs hatch from late May to early June and larvae feed gregariously on old foliage into July. Last instars drop to the ground and pupate in papery, tough cocoons in the duff. Adults emerge from late September to late October and lay eggs in niches cut in needles.

Management—biological control

Sawflies are subject to various viral and fungal diseases. Rodents and birds are important predators, but outbreaks can still occur.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Sawfly" in:
Common Landscape Pests

Pine (*Pinus*)—Powdery pine needle aphid

Eulachnus rileyi

Pest description and damage A powdery gray aphid, from 0.07 to 0.1 inch in length, which occurs all season and can cause early needle drop.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—Sequoia pitch moth

Synanthedon sequoiae

Pest description and damage The adult is a clearwing moth about 1.0 to 1.25 inches in length with yellow and black markings resembling yellowjacket wasps. The larvae are about 1 inch long, yellowish, with a reddish-brown head. Larvae feed by boring into branches or trunks. At the point where the larva enters the wood, small to large masses of creamy yellow to pinkish pitch accumulate. The larva feeds locally underneath the pitch mass. This pest causes mainly aesthetic damage because of the pitch masses. They do not attack sequoia (aka the coast redwood).

Biology and life history Eggs are laid on the bark of host trees. The larvae bore into the inner bark and establish a feeding site. The feeding site are distinguished easily by the large accumulation of pitch and frass on the exterior of the bark. Pupation takes place within this mass, and the adult moths fly through the summer months. About half the population completes its life cycle in one year; the other half requires two years.

Pest monitoring Periodically check pitch masses for the partially emerged pupa case. If the moth has emerged, the pupal case will be papery and empty. Pheromone traps are available to time adult activity and physically remove males.

Management—cultural control

Healthy trees are not commonly attacked. Infestations often are associated with pruning wounds or mechanical damage to the tree. Trees pruned or wounded in the spring and summer when adult moths are flying are far more likely to be attacked than those trees pruned or injured in the fall and winter. The moths are attracted to trees undergoing stresses associated with drought or saturated soil. Remove pitch masses by hand or dig out larvae with a knife.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—Root weevil

Various species

Pest description and damage Identification is important as several species differ in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles, 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size. Larvae are rarely a significant problem in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—Spider mite

Oligonychus spp.
Tetranychus spp.

Pest description and damage Several species of spider mites can cause damage in coniferous ornamentals. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Spider mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants are covered with fine silk webbing at branch axils or over sections, and small plants may be engulfed in webbing under very heavy infestations. Mites damage cone production indirectly by feeding on needles, which causes stippling, bronzing, and possibly needle drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—White pine weevil

Pissodes strobi

Pest description and damage White pine weevils are brown beetles with snouts and elbowed antennae that range from 0.2 to 0.3 inch in length. These weevils have rusty-colored wing covers with black and white patches. Adults grow to about 0.5 inch in length and feed on shoots and needles

of pines and spruces. The larvae feed on needles and mine shoot tips, often distorting or killing back the terminals and causing trees to appear deformed. Infested terminals often develop a "shepherd's crook" appearance. The weevil attacks eastern white pine (*Pinus strobus*), Sitka spruce (*Picea sitchensis*), and a wide variety of other pines and spruce and even Douglas-fir.

Biology and life history Adult beetles overwinter in litter on the ground. In the spring, adults walk or fly to host trees, where they settle on the leader to mate. Eggs are deposited in a cavity made by the female chewing with her snout into the bark of the tree. The eggs hatch, and the larvae commence feeding in the bark, killing the leader. As they feed, the current season's growth is emerging, but this soon collapses, causing the characteristic "shepherd's crook." The larvae then bore into the wood to pupate. The adult weevils emerge in late summer (around mid-August into fall) and overwinter in organic debris on the ground. There is one generation per year.

Management—cultural control

Prune and destroy affected terminals in the summer before adult beetles emerge. This will help reduce next year's infestation.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Pine (*Pinus*)—Woolly pine needle aphid

Schizolachnus piniradiatae

Description, biology and damage Mature woolly pine needle aphids are close to 0.1 inch in length, long-legged, dark green or brown and covered with a white, woolly material. The aphid can be found in colonies among the needles. The aphid produces large amounts of honeydew (a sweet, sticky material) which often is covered by a black growth of sooty mold. Heavy aphid infestations may cause trees to turn yellowish, but otherwise cause only minor damage. Honeydew attracts ants and yellowjackets, wasps and baldfaced hornets.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Plum, flowering (*Prunus*)—Aphid

Hop aphid (*Phorodon humuli*)
Leafcurl plum aphid (*Brachycaudus helichrysi*)

Description, biology and damage The aphids tend to be small (.0625 to 0.125 inch in length), oval- to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. Hop aphids are soft-bodied oval insects with pale yellow green with coalescing stripes that may form patches. Their feeding causes leaves to roll. Typically, the aphids are on the underside of plum leaves, or inside the rolled leaves. Heavily infested plants may drop leaves, resulting in severe defoliation. The leafcurl plum aphid is typically pale green to yellow in color during the summer and darker green to brown later in the year. Feeding by the leafcurl plum aphid causes severe curling of leaves on plum.

Biology and life history The aphid overwinters as eggs in crevices and twigs on plum, prune, or cherry. The eggs hatch near budbreak and the nymphs feed on unopened buds and the underside of the leaves. The leaves curl and protect the aphid as they feed. After two to three generations, winged forms are produced that migrate to summer hosts, which include weeds, ornamental plants, and vegetables. Following several more generations, the winged forms migrate back in the fall to the fruit trees to mate and lay the overwintering eggs. Some aphids remain on the winter host all year round.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Plum, flowering (*Prunus*)—Cherry bark tortrix

Enarmonia formosana

Pest description and damage CBT is a pest of most woody ornamental trees and shrubs in the family Rosaceae. The larvae are 0.33 to 0.4 inch in length, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a yellowish-brown head. Larvae feed directly on the cambium under the tree bark and may cause death of the tree in sufficient numbers. Otherwise, the feeding activity decreases the supply of nutrients to the tree and increases susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the

exuding of reddish-brown, gum-like resin mixed with fecal pellets and silk. The trunk and larger limbs of bearing fruit trees are affected, usually at pruning wounds. The adult moth has a wingspan of about 0.33 inch and is a mottled yellow, cream and brown in appearance.

For biology, life history, monitoring and management

See:

Cherry (*Malus*)—Cherry bark tortrix

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Plum, flowering (*Prunus*)—Peachtree borer

Synanthedon exitiosa

Pest description and damage The adult is a metallic blue-black, clearwing moth. The male moth with a 1-inch wingspan may have bands of light-yellow scale on the abdomen, which makes it resemble a wasp. The female has a 1.25-inch wingspan and an orange band around the abdomen. Full-grown larvae are 1 inch long and whitish with a brown head. The larvae burrow into the bark of the crown and feed on the cambium. Feeding is restricted to an area a few inches above and below the soil line. Peachtree borer feeding damage can girdle and kill younger trees. While older trees are rarely girdled, the damage reduces vigor and makes these trees vulnerable to other pests and diseases. Infested trees exude a reddish-amber gum and frass mixture at the root crown throughout the growing season.

For biology, life history, monitoring and management

See:

Peach, flowering (*Prunus*)—Peachtree borer

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Plum, flowering (*Prunus*)—Peach twig borer

Anarsia lineatella

Pest description and damage Peach twig borer is a European insect first found in California in the 1880s. It is a major pest of apricots, peaches, plums, and prunes. There are no native hosts outside the orchard. The adult is a steel-gray moth with white and dark scale, about 0.33 to 0.5 inch in length. The larva is a caterpillar, approximately 0.5 inch long, with a dark brown head and distinctive, alternating light and dark bands on the body. The pupa is smooth and brown. The larva of the borer causes injury to fruit and trees. Feeding on the buds and twigs occurs early in the season, after which the larva bores into the shoots, causing a characteristic “flagging” or wilting of the new growth. Later generations of larvae feed on shoots or fruit, disfiguring the fruit.

For biology, life history, monitoring and management

See:

Peach (*Persica*)—Peach twig borer

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Plum, flowering (*Prunus*)—Pear sawfly (pear slug)

Caliroa cerasi

Pest description and damage Pear slug is found in most areas of the U.S. It attacks pear, cherry, and other ornamental Prunus. The adult is a glossy black fly-like insect, about 0.2 inch in length. The larva initially resembles a small tadpole due to the olive-green slime that covers the body, and the head being wider than the rest of the body. Mature larvae are 0.375 inch long and orange yellow. Larvae feed on the upper surface of leaves, skeletonizing them. Heavy feeding causes leaf drop, with reduction in vigor and yield, particularly on young trees.

For biology, life history, monitoring and management

See:

Pear, flowering (*Pyrus*)—Pear sawfly (pear slug)

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Plum, flowering (*Prunus*)—Lecanium scale

Includes *Parthenolecanium corni* and others

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Lecanium scale insects are most noticeable as the female scales expand in size in the spring. As females swell in the spring, they produce large egg masses under their scales and release considerable honeydew that coats nearby foliage. Female lecanium scales are about 0.125 inch in diameter and vary from red to dark brown in color. They are oval and raised, resembling small "helmets," "turtles," or bumps on branches, and stems. Male scales are smaller, flat, and oblong. The crawlers are pale yellow and feed on the undersides of leaves. They also produce honeydew.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Plum, flowering (*Prunus*)—Tent caterpillar

Forest tent caterpillar (*Malacosoma disstria*)
Western tent caterpillar (*Malacosoma californica*)

Pest description and damage The western tent caterpillar attacks a wide variety of plants, including alder, ash, birch, cottonwood, and willow—as well as fruit trees and roses. The over 1-inch adult moths are attracted to lights at night. Mature western tent caterpillars can reach a length of about 2.0 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.0625 inch in length, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

For biology, life history, monitoring and management

See:

Alder (*Alnus*)—Tent caterpillar

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Poplar (*Populus*)—Aphid

Includes
Poplar petiolegall aphid (*Pemphigus populitransversus*)
Pemphigus populicaulis

Pest description and damage There are nearly a dozen aphids that feed on poplar leaves, petioles, stems, and bark. Many have herbaceous alternate hosts such as the poplar-lettuce root aphid. This aphid can be distinguished from other aphids by their short antennae (less than one-third body length) and undeveloped cornicles. Adult aphids within the galls and migrating adults are 0.06 to 0.1 inch in length. These aphids feed on the leaf petioles, or along the midrib causing these tissues to enlarge and enclose the aphids. The hard, pale green, rounded galls form along the petiole or at the base of the leaf or as a swelling along the midvein. Aphids inside the galls appear grayish and waxy. The leaves are not damaged but may be turned at right angles to the petiole. Aphids cause little damage to poplars but may be serious pests to their summer hosts such as mustard, buttercup, lettuce, turnip, beet and sugar beet, and aster.

Biology and life history Where lettuce or related weeds are not available, these aphids overwinter in the egg stage on the bark of Lombardy poplar. They develop into adults and reproduce once on poplar before migrating to summer hosts in *Brassica* or *Aster* species. In late summer, winged forms reappear, and these migrate back to poplar to mate and lay eggs.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

See "Gallmakers" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Poplar (*Populus*)—Azalea bark scale

Eriococcus azaeleae

Pest description and damage The immature scales superficially resemble mealybugs in appearance. Mature female scales are about 0.125 inch in length and appear like white cottony sacs, often located on twigs and stems of azalea, especially in branch axils. Eggs, crawlers, and the scales under the wax are red.

For biology, life history, monitoring and management

See:

Azalea (*Rhododendron*)—Azalea bark scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Poplar (*Populus*)—Carpenterworm

Prionoxystus robinae

Pest description and damage Carpenterworms are the larvae of a large, mottled gray and black moth (goat moth). The caterpillars are white to pinkish red with a dark head and are 1 to 3 inches in length when mature. The caterpillars bore in the trunk and main branches. Discolored or bleeding limbs, branch dieback, and lumpy or gnarled trunks may be indications of carpenterworm infestation. Trees with severe carpenterworm infestations are susceptible to wind breakage and may need to be removed. Infestations may kill trees eventually.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Carpenterworm

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Poplar (*Populus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are covered with yellow, rusty then black colored silky hairs. Adult moths have a 1-inch wingspan and are bright white with orange and black markings on the underside of the abdomen. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Poplar (*Populus*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage The mature scale insect is approximately 0.125 inch in length beneath a pinkish brown or gray scale that is usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are found on trunks, branches, and twigs of many broad-leaved deciduous plants. They occur less frequently on the leaves and other plant parts. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Newly emerged crawlers look like bright white pimples on the bark.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Oystershell scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Poplar (*Populus*)—Poplar-and-willow borer

Cryptorhynchus lapathi

Pest description and damage The adult poplar-and-willow borer is a black and pink to cream-colored weevil (a flightless snout beetle) about 0.375 inch in length. The larvae are white, legless, and about 0.25 long at maturity. Larvae feed by mining beneath the bark of trunk and branches. In late summer, feeding larvae expel large quantities of sawdust-like frass (excrement) through holes in the bark accompanied by flow of a thin sap. Larval feeding may girdle branches, resulting in breakage, leaf wilt or eventual branch death. Severe infestations cause lumpy, swollen bark, with cracks and bark scars with exposed wood. Old wood may produce large numbers of new shoots. Willows are the preferred host, but the poplar-and-willow borer also attacks poplars. The adults chew small holes in the bark of twigs and shoots, introducing a fungus that may cause shoots to wilt. This insect has become a serious problem in hybrid poplar plantations, and in willows grown for the cut flower industry and restoration plantings. In landscapes, damage is most common on native willows.

For biology, life history, monitoring and management

See:

Willow (*Salix*)—Poplar-and-willow borer

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Poplar (*Populus*)—Rose leafhopper

Includes *Edwardsiana rosae*

Pest description and damage Rose leafhoppers are small (roughly 0.15 inch in length), active, whitish-green insects which run forward, backward, or sideways when disturbed. The nymphs (immature) are white with red eyes. Rose leafhoppers feed on the leaves, causing white or pale blotches that resemble, but are larger than, spider mite stippling. Injured leaves may drop prematurely. The egg-laying in the fall also wounds the canes, providing entry points for fungal pathogens. Cast skins are found on the undersides of leaves. Leafhopper damage is mainly aesthetic.

For biology, life history, monitoring and management

See:

Rose (*Rosa*)—Rose leafhopper

See "Leafhopper" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Poplar (*Populus*)—Satin moth

Leucoma salicis

Pest description and damage The adult moth (over 1 inch wingspan) is satiny white with black markings on the legs. Larvae are approximately 2 inches in length when grown and reddish brown with double white patches on top and tufts of hairs along the sides. They can seriously defoliate cottonwood, poplar, and willow. They occasionally attack oak and aspen, Lombardy poplar and silver maple.

Biology and life history The insect overwinters as larvae in a small silken cocoon attached to the trunk or branch of the host tree. The larvae become active and feed after leaves have fully formed in the spring. After pupation, the adult moth emerges in midsummer. The adult moths are attracted to lights. The females lay eggs in masses on host plants, often on the leaves, but also on bark. After hatching, the young larvae feed until fall, then hibernate. There is one generation per year.

Pest monitoring Watch for signs of skeletonizing by the newly hatched larvae in fall and resumption of feeding in early spring as new growth develops.

Management—biological

Look for evidence of parasitoid wasp cocoons in the bark crevices. There are native, as well as four introduced, parasitoids in Canada. Parasitoids may cause the sudden decline in numbers just when defoliation is greatest and larvae are most noticeable and abundant. It may be even more important to monitor for parasitoids at that time.

Management—cultural control

Larvae and pupae may be removed from affected leaves. Remove heavily infested twigs. Use light to attract females to small host trees to determine egg hatch and caterpillar feeding to better launch control measures.

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:

Common Landscape Pests

Privet (*Ligustrum*)—Lilac leafminer

Gracillaria syringella

Pest description and damage The adult insect is a golden yellow moth about 0.5 inch in length. The larvae are small, pale yellow to green caterpillars, 0.125 to 0.25 inch long. The larvae mine leaves causing brown wrinkling on leaf surfaces during the early part of their development. Later larval instars are responsible for rolling and skeletonizing leaves.

For biology, life history, monitoring and management

See:

Lilac (*Syringa*)—Lilac leafminer

Common Landscape Pests

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Privet (*Ligustrum*)—Thrips

Frankliniella spp.

Pest description and damage Several species of thrips cause injury to many woody ornamentals. All are very small insects, less than 0.05 inch in length. Body color varies from reddish yellow to mid-dark brown. Winter populations are darker in color. Thrips have rasping mouthparts and damage plants by sucking on the contents of plant cells. Thrips can damage flower buds, opened flowers, and leaf buds. Damage to flowers appears as streaking in the blossoms and a reduced flower life. Damage to foliage is particularly noticeable if it occurs in the bud stage. In this case, leaves typically are distorted and may be flecked with yellow pollen.

For biology, life history, monitoring and management

See "Thrips" in:

Common Landscape Pests

Management—Chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Quince, flowering (*Cydonia*)—Cherry bark tortrix

Enarmonia formosana

Pest description and damage Cherry bark tortrix is a pest of most woody ornamental trees and shrubs in the family Rosaceae. The larvae are 0.33 to 0.4 inch in length, pale gray to flesh-color with small, pale gray spines scattered on the surface, with a yellowish-brown head. Larvae feed directly on the cambial tissues of the tree and may cause death of the tree in sufficient numbers. Otherwise, the feeding activity decreases the supply of

nutrients to the tree and increases susceptibility to disease, insect attack, and environmental stress, including cold injury. The first indication of attack is the exuding of reddish-brown, gum-like resin, which often is mixed with fecal pellets and silk. The trunk and larger limbs of trees are affected, usually at pruning wounds and graft unions. The adult moth has a wingspan of about 0.33 inch and is a mottled yellow, cream and brown in appearance.

For biology, life history, monitoring and management

See:

Cherry (*Malus*)—Cherry bark tortrix

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Rhododendron (*Rhododendron*)—Aphid

Includes *Illinoia rhododendri* and others

Pest description and damage Rhododendron aphids are 0.09 to 0.13 inch in length and often spotted first by the cast exoskeletons of the aphids covering buds and sticky new growth. By then the aphids may have flown. They are soft-bodied insects with piercing–sucking mouthparts. Their color varies from pink to green. Feeding damage to mature plants is usually minor but can compromise the vigor of small plants. Leaves, infested as they expand, are somewhat smaller and distorted with wavy edges. The health of established landscape plants is not threatened by aphid feeding activities.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Rhododendron (*Rhododendron*)—Azalea bark scale

Eriococcus azaleae

Pest description and damage The immature scales superficially resemble mealybugs in appearance. Mature female scales are about 0.125 inch in length and appear like white cottony sacs, often located on twigs and stems of azalea, especially in branch axils. Eggs, crawlers, and female scales under the white cotton are red.

For biology, life history, monitoring and management

See:

Azalea (*Rhododendron*)—Azalea bark scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Rhododendron (*Rhododendron*)—Azalea and rhododendron lace bug

Azalea lace bug (*Stephanitis pyrioides*)
Rhododendron lace bug (*Stephanitis rhododendri*)

Pest description and damage Lace bugs use piercing–sucking mouthparts to feed on individual cells, so the upper leaf surface is yellow and stippled. The underside of leaves is covered with varnish-like "tar" spots. Infestations are more severe on plants in the sun. Damage is usually apparent by early to mid-July. While almost never fatal, repeated infestations of rhododendron lace bugs may result in yellowed, sickly plants. Adult insects are whitish-tan and approximately 0.125 inch in length with lacy-looking wings. Nymphs grow to about 0.13 inch and are spiny. The damage the insects cause is similar on first inspection to that of leafhoppers but for the presence of tar spots. Identification is based on the dark markings on the thorax and wings.

For biology, life history, monitoring and management

See:

Azalea (*Rhododendron*)—Azalea and rhododendron lace bug

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Rhododendron (*Rhododendron*)—Carnation tortrix

Cacoecimorpha pronubana

Description, biology and damage The larvae feed by rolling leaves and tying them with silk webbing. The caterpillars are light brown or greenish with brown heads and are about 0.375 to 0.5 inch in length at maturity. The larvae are very active when disturbed. The carnation tortrix caterpillar attacks many broadleaf evergreen plants but seldom causes serious damage. Larvae are active year-round. Rarely becomes a serious pest. This is a small (0.5-to-0.9-inch wingspan), bell-shaped brown moth with reddish underwings and dark bands on the upper wings.

For biology, life history, monitoring and management

See "Leafroller and leaftier" in:

Common Landscape Pests

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Rhododendron (*Rhododendron*)—Cottony cushion scale

Icerya purchasi

Pest description and damage Female cottony cushion scales are orange, yellow, or brown, but their most distinguishing feature is the elongated, ribbed, white cottony egg sacs attached to their body. The egg sac contains from 600 to 800 red eggs and may be longer than the body of the female; the resulting length of the female plus the egg sac can be from 0.2 to almost 0.5 inch. Eggs hatch into crawlers, which are red with black legs and antennae. They settle along leaf veins and produce the white cottony secretion for which they are known.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Rhododendron (*Rhododendron*)—Lecanium scale

Includes *Parthenolecanium corni*

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Lecanium scales are most noticed as the female scales expand in size in the spring. As females swell in the spring, they produce large egg masses under their scales and release considerable honeydew that coats nearby foliage. The female lecanium scales are about 0.125 inch in diameter and vary from red to dark brown in color. They are oval and raised, resembling small "helmets," "turtles," or bumps on branches, stems, while crawlers feed on the undersides of leaves. Male scales are smaller, flat, and oblong.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Lecanium scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Rhododendron (*Rhododendron*)—Rhododendron whitefly

Dialeurodes chittendeni

Pest description and damage Whiteflies are small (0.04 to 0.08 inch in length) white insects that hold their wings roof-like over their abdomens rather than flat like true flies. Infested leaves, usually the tender young leaves at the branch tips, are mottled yellow on the upper surface, and the margins often curl. Rhododendron whiteflies often leave white, sometimes circular, powdery residues on the leaf surface. Whiteflies can produce

large amounts of sticky honeydew, which can develop a heavy coating of black sooty mold. The rhododendron whitefly is mainly an aesthetic pest, although heavy infestations can damage susceptible plants.

Biology and life history The insect overwinters as a nymph. There are several species of whiteflies. Some overwinter as adults on the undersides of evergreen leaves (salal, Oregon grape, rhododendron). These disappear in spring, leaving no offspring or damage to these leaves. Adults occur from mid-May to early August. Tiny black eggs are laid in circles, half-circles, or they are scattered about singly on the undersides of leaves. There is one generation per year.

Management—cultural control

Rhododendron species with smooth surfaces underneath the leaf are most affected. Species with thick and leathery epidermis are often unaffected. Do not over fertilize. Whitefly numbers increase with increasing foliar nitrogen levels. If necessary, switch to a slow-release fertilizer and/or one with less nitrogen. Lightly vacuum plants in the early morning to remove adult whiteflies when they are cold and less likely to fly away. Whiteflies are also known to spend winter under rhododendron leaves without establishing on those plants. Check for eggs, or larvae to be sure that there is a live population.

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

For more information

See "Whitefly" in:

Common Landscape Pests

For more information

Flint, M.L. 2002. Whiteflies. UC-IPM On-Line (https://ipm.ucanr.edu/PMG/PESTNOTES/pn7401.html)

Rhododendron (*Rhododendron*)—Root weevil

Numerous species

Pest description and damage Identification is important as root weevil species differ in susceptibility to pesticides. Adult weevils are dark colored, nocturnal beetles from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves, or flower petals. Larvae are C-shaped, legless, and white, sometimes reddish, with tan heads, up to 0.5 inch in size. Larvae rarely cause significant root girdling damage in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Rockrose (*Cistus*)—Root weevil

Numerous species

Pest description and damage Identification is important: species differ in susceptibility to pesticides and may have different life cycles. Adult weevils are dark colored, nocturnal beetles from 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. In addition to the ragged notches in leaves the weevils may girdle some of the stems resulting in dead branch tips. The C-shaped, legless weevil larvae are white with tan heads, up to 0.5 inch in size. They rarely cause significant damage in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Rose (*Rosa*)—Aphid

Macrosiphum rosae

Description, biology and damage Rose aphids are small (roughly 0.16 inch in length), soft, pinkish or green insects found on the succulent new growth, including buds and stems. White cast skins also may be present even after the aphids have moved on to other hosts. Often the damage is

negligible, but heavy aphid feeding can reduce the quantity and quality of the flowers produced and for rose growers, may mar the perfection of the outer petals important in showing roses.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Rose (*Rosa*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inch in length, covered with yellow, rusty then black colored silky hairs. Adult moths have a 1-inch wingspan and are bright white with orange and black markings on the underside of the abdomen. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Rose (*Rosa*)—Gall wasp

Mossy rose gall wasp (*Diplolepis rosae*)
Spiny rose gall wasp (*Diplolepis bicolor*)

Pest description and damage The mossy rose gall wasp and spiny rose gall wasp are both tiny (0.12 to 0.24 inch in length) wasps which induce galls that may measure from 2 to 4 inches in diameter to form on the leaves. Galls may form on leaves, stem, bud, or root. The larva of the wasp is inside the gall. The appearance of the two galls is different. The mossy rose gall wasp causes a cluster of hard, kernel-like cells to form on the rose stem or leaf, with moss-like filaments all over it. The spiny rose gall has a spherical hard body with many spiky protrusions. Other gall wasps cause buds to enlarge and harden.

Biology and life history The insect overwinters as a larva in the gall, and in early spring the adult wasp matures and chews out through the gall. It looks for expanding leaf tissue to lay eggs on. The eggs hatch and the feeding of the larvae induces the gall to form around it. There is one generation per year.

Pest monitoring In late winter, place a few galls in a baggy and leave outside in a protected location. Check regularly for the emergence of the first gall wasps. Then confirm that there are emergence holes in galls on the plants.

Management—cultural control

Cut out galls when they are still green and fresh and before gall wasps have emerged and flown away. Adult emergence is in spring, so late summer and winter removal of the galls works best. Old galls have holes and become brown and matted.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

For more information

See "Gallmakers" in:

Common Landscape Pests

Rose (*Rosa*)—Leafcutting bee

Megachile spp.

Description, biology and damage Leafcutting bees are about 0.4 inch in length, black with white stripes and look like small bumblebees. Female leafcutting bees remove smooth oval, circular or semicircular notches from the edges of leaves of roses and other plants. These leaf pieces create protective cells for raising their young. Leafcutting bees are important pollinators and seldom do major harm to plants.

Rose (*Rosa*)—Rose leafhopper

Includes *Edwardsiana rosae*

Pest description and damage Rose leafhoppers are small (range from 0.14 to 0.16 inch in length), active, whitish-green insects which run forward, backward, or sideways when disturbed. The nymphs (immature) are white with red eyes. Rose leafhoppers feed on the leaves, causing tiny, white, or pale stippling or blotches that resemble, but are larger than, spider mite stippling. Injured leaves may drop prematurely. The egg-laying in the fall also wounds the canes, providing entry points for fungal pathogens. Cast skins are found on the undersides of leaves. Leafhopper damage is mainly aesthetic.

Biology and life history The insect overwinters as eggs within the cane bark of wild or cultivated rose or on caneberries. Eggs hatch in the spring, and the emerging nymphs feed on the leaves. When mature, the nymphs may leave roses for summer hosts that include species of *Cornus, Quercus, Prunus, Crataegus, Malus, Populus,* and *Acer*. There are several generations each year (three in eastern Washington).

Pest monitoring Check for leafhoppers and shed skins early in the season to determine if any treatment is needed.

Management—cultural control

Leafhopper damage is mainly aesthetic. Tolerate this cosmetic damage, unless there is evidence the infestation will be more severe than usual.

Management—biological control

Several natural predators feed on leafhoppers, including damsel bugs and assassin bugs. Avoid use of broad-spectrum insecticides that may kill these predators.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more information

See "Leafhopper" in:
Common Landscape Pests

Rose (*Rosa*)—Leafroller

Includes
European (filbert) leafroller (*Archips rosana*)
Fruittree leafroller (*Archips argyrospila*)
Oblique-banded leafroller (*Choristoneura rosaceana*)
Pandemis leafroller (*Pandemis pyrusana*)

Pest description and damage These leafrollers are tortricids, noted for wriggling backwards quickly. They become small moths. They all cause similar damage but differ in their appearance and, more importantly, in their life cycle. The leafroller pests are divided into single-generation moths, such as the fruit tree leafroller and the European leafroller, and two-generation moths, such as the oblique-banded leafroller and pandemis leafroller. The larvae are mostly green caterpillars with a light brown to black head. Mature larvae range from 0.75 to 1.0 inch in length. The 0.5- to 1.0-inch-long adult moths have distinctive bands or mottling on the wings but are rarely seen except when pheromone traps are used to monitor them.

For biology, life history, monitoring and management

See:
Cherry, flowering (*Prunus*)—Oblique-banded leafroller

See "Leafroller" in:
Common Landscape Pests

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Rose (*Rosa*)—Raspberry cane maggot

Pegomya rubivora

Pest description and damage The mature cane maggot is about 0.3 inch in length and is the larva of a small (less than 0.2 inch) gray fly that feeds on the cambial tissues of host plants. The larvae are white and legless and feed while tunneling downward in new canes. Canes are usually 1 to 3 feet long when attacked. Young shoots wilt suddenly, and a purple discoloration appears where the maggot girdles the cane. This causes a distinct drooping, a condition often referred to as "limber neck." Canes also may show a characteristic swelling where feeding is occurring. This usually is not a serious pest. It is more often a pest of blackcaps and other cane fruits.

Biology and life history The insect overwinters as a pupa in the soil. The adult flies emerge in April. The female deposits eggs near the tops of the young canes. After hatching, the young maggots burrow into the pith of young shoots and tunnel downward. Later feeding involves girdling the cane just under the bark.

Pest monitoring Remove and burn wilted canes as soon as they are seen. Cut canes off near the base. Little loss is caused by this insect even when 60 to 70% of new canes are infested.

Management—cultural control:

Cut off infested canes several inches below the wilted portion.

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Rose (*Rosa*)—Western red-humped caterpillar

Oedemasia salicis

Pest description and damage The red-humped caterpillar is the larva of a 1 inch, gray-brown moth. The mature larvae are yellow with a red head, and the fourth segment is humped. The body has orange, black, and white lengthwise stripes, as well as dark, fleshy "spikes" on it. Young red humped caterpillars are found in clustered colonies that disperse as caterpillars mature. They eat entire leaves (except the major veins) and can cause considerable defoliation. They have been a problem on cherry and other hosts east of the Cascade Mountains.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Caterpillar" in:
Common Landscape Pests

Rose (*Rosa*)—Root weevil

Numerous species

Pest description and damage Identification is important as multiple species differ in susceptibility to pesticides and may have different life cycles. Adult weevils are dark colored, nocturnal beetles, 0.2 to 0.25 inch in length, with a snout (rostrum) and elbowed antennae. In addition to the ragged notches in leaves, the weevils may girdle some of the stems resulting in dead branch tips. The C-shaped, legless weevil larvae are white with tan heads, up to 0.5 inch in size. They rarely cause significant damage in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Rose (*Rosa*)—Rose curculio

Merhynchites bicolor

Pest description and damage Dull red beetle, 0.25 inch in length, with black undersurface, head, and legs, and long snout. One form is entirely black. Adults make egg punctures in buds, which may fail to open. If flowers are not available, they may feed on and kill the tips of the growing shoots. Typically, this pest does not jeopardize the overall health of the plant; however, when damaged flower buds open, the multiple petals will have a hole where the weevil chewed into the bud.

Biology and life history The insect overwinters as a larva in the soil and pupates in the spring. The adult beetle emerges in spring to feed on the host

plant. Females lay eggs on the flower buds. The larvae feed on reproductive parts of the flower, then drop to the soil to overwinter.

Management—cultural control

Pick off adults when seen.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Rose (*Rosa*)—Rose midge

Dasineura rhodophaga

Pest description and damage The rose midge is a tiny (about 0.05 inch in length) yellow-brown or reddish fly that lays its eggs in newly developing bud and shoot tips. The hatching maggots feed on the growing tips or new rose canes. The mature maggots are about 0.0625 inch long and white to reddish in color. New buds and shoots are deformed and killed, and the dead tissues turn brown or black. Abnormal flowers develop from damaged buds.

Biology and life history The insect overwinters as a pupa in the soil under plants. Adults emerge in spring, and females lay eggs under the sepals of flower buds or on expanding leaf buds or shoots. The larvae emerge, and their feeding causes damaged tissue to turn brown, then black. The larva then drops to the soil to pupate. There are several generations per year.

Management—cultural control

Cut out and destroy infested tips.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Rose (*Rosa*)—Rose sawfly

Includes
Bristly roseslug (*Cladius pectinicornis*)
Curled rose sawfly (*Allantus cinctus*)
Roseslug (*Endelomyia aethiops*)

Pest description and damage These pests are larvae of small (from 0.2 to 0.3 inch in length) black wasps called sawflies. Roseslugs are small yellow-green larvae, about 0.25 inch long that skeletonized the upper leaf surface of roses. The bristly roseslug is about 0.5 inch long and has spiny hairs while the roseslug larva is hairless. The curled rose sawfly is 0.5 to 0.8 inch in length, darker green, and is often found curled on the leaf. Signs of feeding include dry brown blotches where all the leaf except the veins and the lowest layer of leaf tissue are removed. Roseslugs rarely occur in large numbers but may do considerable aesthetic damage. Curled rose sawfly consumes, rather than skeletonizes the leaves.

Biology and life history Rose is the only food of this insect. The female lays eggs in pockets on the edges of the leaves. The larvae emerge and feed on the surface of the leaf. When fully grown, the larva drops to the soil to pupate. There are one or two generations per year depending on the species.

Pest monitoring Watch for the first “windows” to appear in leaves in the spring. Controlling the first generation reduces damage from subsequent generations.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See “Sawfly” in:
Common Landscape Pests

Rosetta, R. 2009. Roseslug. Oregon State University Nursery IPM. (http://oregonstate.edu/dept/nurspest/roseslug.htm)

Rose (*Rosa*)—Rose stem miner

Marmara spp.

Pest description and damage The legless larvae of this leaf- and twig-mining moth make sinuous, serpentine mines across the undersides of leaves. Where they cut through veins, the distal portion of the leaf may fade in color. Although damage is unsightly on individual leaves, they do not affect the long-term health or aesthetic quality of the plant. The moths are frequently black with horizontal stripes.

Management—cultural control

If mines detract from the plant's appearance, prune, or pick off and destroy infested leaves and canes. Rose stem miner is rarely a serious problem.

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Rose (*Rosa*)—Small carpenter bee

Ceratina spp.

Pest description and damage Small bees, 0.18 inch in length and metallic blue or blue-green, burrow into the pith of cut stems to create cells for their young. Cells are provisioned with pollen and nectar. Damage is not serious. These bees can burrow only in pruned stems.

Biology and life history Females overwinter as adults in partially or completely excavated stems. In the spring, the female modifies this resting place (hibernaculum) into a brood nest by further excavation. When a desired depth is reached, she collects pollen and nectar, places this mixture at the base of the burrow, lays an egg on the provision, and then caps off the cell with plant material. Several cells are constructed end to end in each plant stem. The maturing bees then chew their way out of the stem.

Management—cultural control

Cover cut stems ends with wax to prevent burrowing and egg laying. Prune out and destroy or burn damaged canes in winter where females are hibernating and before they emerge in spring.

Rose (*Rosa*)—Spider mite

Panonychus ulmi
Tetranychus spp.

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen, and coniferous ornamentals. Appearance of these mites varies with the species, although all spider mites are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Spider mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants are covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites damage leaves and fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Rose (*Rosa*)—Tent caterpillar

Forest tent caterpillar (*Malacosoma disstria*)
Western tent caterpillar (*Malacosoma californica*)

Pest description and damage The western tent caterpillar attacks a wide variety of plants including alder, ash, birch, cottonwood, and willow as well as fruit trees and roses. The over 1-inch-long adult moths are attracted to lights at night. Mature western tent caterpillars can reach a length of about 2.0 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.625 inch in length, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

For biology, life history, monitoring and management

See:

Alder (*Alnus*)—Tent caterpillar

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Rose (*Rosa*)—Thrips

Western flower thrips (*Frankliniella occidentalis*) and other species

Pest description and damage Several species of thrips cause injury to many woody ornamentals. All are very small insects, less than 0.05 inch long. Color varies from reddish yellow to mid-dark brown. Winter populations are darker in color. Thrips have rasping mouthparts and damage plants by sucking on the contents of plant cells. Tiny specks of honeydew or black fecal tar spots are found, and leaves are bleached and silvered by feeding activities of thrips. Thrips can damage flower buds, flower petals, and leaf buds. Damage to flowers appears as streaking in the blossoms and a reduced flower life. Damage to foliage is particularly noticeable if it occurs in the bud stage. In this case, leaves and flower petals typically are distorted.

For biology, life history, monitoring and management

See "Thrips" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Rose (*Rosa*)—Western spotted cucumber beetle

Diabrotica undecimpunctata

Pest description and damage The adult beetle is yellowish green, 0.25 inch in length, and has eleven black spots on its wing covers. Mature larvae are white, except for the head and last abdominal segment, which are brown. They are about 0.625 inch in length. The larvae appear to have "two heads." The adult beetles eat small holes in the leaves and blossoms. Larvae feed on roots and bore into the base of stems, killing small plants and reducing root mass in mature plants.

For biology, life history, monitoring and management

See:

Dahlia (*Dahlia*)—Western spotted cucumber beetle

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Sequoia/Redwood (*Sequoia*)—Juniper scale

Carulaspis juniperi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The female juniper scale insect is approximately 0.05 to 0.1 inch in diameter and white with a notable central yellow spot. The male scale has a more elongated appearance. This insect feeds on the sap within the stem or leaf. Leaves, twigs, branches, and cones are attacked. Scale insect feeding can reduce the vigor of the foliage supported by that stem. Symptoms of scale feeding include loss of normal color and luster of foliage, no new growth, and yellowing and death of branches. Though uncommon, severe infestations may kill entire plants or small trees.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Skimmia (*Skimmia*)—Spider mite

Includes
Brown mite (*Bryobia rubrioculus*)
Citrus red mite (*Panonychus citri*)
Spider mite (*Tetranychus* spp.)

Pest description and damage Several species of spider mites can cause damage in ornamental hosts. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Spider mites are oval and yellowish-brown or green with distinctive black spots on the body. Plants are covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mite damage to leaves causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

For more information

Brown mite http://jenny.tfrec.wsu.edu/opm/displaySpecies.php?pn=293

Spiraea (*Spiraea*)—Aphid

Green apple aphid (*Aphis pomi*)
Spirea aphid (*Aphis spiraecola*)

Pest description and damage These two aphids are virtually indistinguishable so are often treated the same. Aphids tend to be small (0.0625 to 0.125 inches), oval- to pear-shaped, soft-bodied insects with piercing–sucking mouthparts. In some cases, spirea aphid is more common in apples than the apple aphid or green apple aphid. Both are yellowish green with dark eyes and short antennae. Mature wingless aphids are bright green with black cornicles, legs, and antennal tips. The winged adults have a dark, more elongated head and thorax, and yellow-green abdomen and whitish wings.

Biology and life history The aphids overwinter as shiny black, rounded eggs laid on smooth twigs and watersprouts. They are similar in appearance to the rosy apple aphid and the apple grain aphid. The aphids hatch as new growth emerges from the bud. The young females (called stem mothers) produce winged and wingless females parthenogenetically (females require no males) and produce live young. It takes 10-20 days (temperature dependent) to complete a generation and there can be 9-16 generations in a year.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

References:

Beers, E.H., S.C. Hoyt, and M. J. Willett.1993. Apple aphid and Spirea aphid (http://jenny.tfrec.wsu.edu/opm/displaySpecies.php?pn-380)

Spiraea (*Spiraea*)—Snapdragon plume moth

Stenoptilodes antirrhina

Pest description and damage Adult is a grayish to tan T-shaped moth with slender, plumed wings and a 0.5-inch wingspan. The small greenish larvae are about 0.5 inch long when mature. The larvae initially mine within leaves. Later, they feed on terminal leaves and bore into developing flowers and inside the stems.

Biology and life history The insect usually overwinter as an adult. In the spring, the eggs are laid on newly forming flowers or on the underside of leaves of terminal young growth. Hatching occurs in two to three weeks. Young larvae mine in leaves and later burrow into the stem, petioles, flowers, or seed pods. It takes three to five weeks for the larvae to develop through four instars. The caterpillars form pupae that hang upside down on the plant. The adults are weak fliers and usually remain on or near the host plant. The moths are most active during the early evening and found hanging around porchlights in the early morning.

For monitoring and management

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Spiraea (*Spiraea*)—Spider mite

Tetranychus spp.

Pest description and damage Several species of spider mites can cause damage to spiraea. Appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Twospotted mites are oval and yellowish-brown or green with distinctive black spots on the

body. Plants are covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites damage spiraea by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and seed productivity.

For biology, life history, monitoring and management

See "Spider mite" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Spruce (*Picea*)—Carnation tortrix

Cacoecimorpha pronubana

Description and crop damage Larvae are active, dark green, about 0.37 to 0.5 inch in length when mature, with a light brown to greenish brown head. This pest attacks many broadleaf evergreens. Caterpillars weave needles together and feed within, causing small brown clusters of dead terminals. Larvae are active year-round. This is a small (up to 0.9-inch wingspan), bell-shaped brown moth with reddish underwings and dark bands on the upper wings.

For biology, life history, monitoring and management

See "Leafroller" in:

Common Landscape Pests

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 3 in:

Chemical Control of Landscape Pests

Spruce (*Picea*)—Coneworm

Dioryctria spp.

Pest description and damage Adult coneworms are mottled gray or brown snout moths banded with subtle waves of color and about 0.6 to 0.7 inch in length. The coneworm larvae are small and cream-colored or light brown with a darker head. Coneworms attack true firs by boring into shoot tips or stems, especially around wounds, and feeding on the soft bark tissues. The portion of the branch beyond the injured point may die back. Coneworms also may bore into green cones, feed on the soft bark of young growth, or feed inside the bark on the trunk cambium. Confounding the issue are insects of other orders that attack cones and several small moths that bore into shoots.

For biology, life history, monitoring and management

See:

Douglas-fir (*Pseudotsuga*)—Coneworm

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Spruce (*Picea*)—Cooley spruce gall adelgid

Includes *Adelges cooleyi* and other species

Pest description and damage Many species of this aphid-like insect feed on newly growing needles of spruce although each species forms unique galls in different sectors of the tree. The adelgids fly to spruce from Douglas-fir, then begin to excrete waxy filaments. Within the protection of the filaments, the small purplish female lays clusters of tan eggs. The eggs hatch and the nymphs begin to feed on the expanding new growth needles. The needle bases swell, encasing the nymphs within the protective, green cone-like galls. In July, the galls dry and crack open, releasing the adelgids, which then fly to Douglas-fir. On Douglas-fir, feeding on the needles only causes some yellowing and minor distortion of the needles (no galls). On spruce, feeding and galls can significantly disfigure branches of the tree. Adults are around 0.07 inch in length.

Biology and life history In spring, winged adelgids fly to spruce where they form cottony tufts within which to lay clusters of eggs. When the crawlers hatch, they move the expanding buds and begin to feed on needles. In response, the bases of the needles begin to swell over the crawlers. As the needle bases swell, they form a cone-like gall. These distinctive galls are green through spring and early summer, but later they begin to dry up. As they dry, they shrink and crack open, releasing the adelgids. The adelgids then fly to Douglas-fir where they will cycle a generation then return to spruce.

Management—cultural control

Plant Douglas-fir and spruce as far apart as possible. Hand-prune and destroy any gall on spruce before these galls open.

Management—biological control

The usual adelgid and aphid parasitoids and predators, including small birds.

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

For more management options

See "Gallmakers" in:
Common Landscape Pests

Spruce (*Picea*)—Douglas-fir tussock moth

Orgyia pseudotsugata

Pest description and damage The adult male moth is brown to gray, about 1 inch across. During the day, the male flies in search of the wingless adult female. Once mated, the female moth lays eggs in a cluster. The hatching larvae disperse by drifting about on a thread in the breeze. Mature larvae are about 1 inch in length, hairy, gray, or light brown, with black heads. They have three long tufts of black hairs on their body (two in front, one in back) and lighter tufts along their back. The hairs from tussock moth caterpillars break off easily and may cause skin or respiratory irritation. The preferred hosts are Douglas-fir and true firs, but also include spruce, pine, and larch. The larvae feed mainly on forest trees and are infrequent pests in the landscape. The larvae start at branch tips at the top of the tree and work down, feeding mainly on the new foliage and causing severe defoliation.

For biology, life history, monitoring and management

See:
Douglas-fir (*Pseudotsuga*)—Douglas-fir tussock moth

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Spruce (*Picea*)—Hemlock scale

Abgrallaspis ithacae

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Hemlock scale insects feed on the needles of Eastern hemlock (*Tsuga canadensis*) and spruces (especially Colorado blue spruce). Adult scales are round to oval, dark gray or black, and about 0.1 inch in diameter. Immature scales (crawlers) are green to yellow. Scales typically are found as small bumps on the underside of needles. Scales feed on the needles by sucking out the cell contents. The initial symptom of infection is yellow spots on the upper surface of the needles. As few as four to six scale insects per needle will cause needle-drop. Colorado blue spruce loses large numbers of needles. Severe infestations may weaken trees sufficiently to cause death. The hemlock scale is most common on stressed trees.

For biology, life history, monitoring and management

See:
Hemlock (*Tsuga*)—Hemlock scale

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Spruce (*Picea*)—Pine needle scale

Chionaspis pinifoliae

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant

preferences. Pine needle scales are about 0.1 inch in length, elongate, white scales that are found on and feed on the needles. Heavily infested trees may appear "flocked." Infested needles turn yellow, then brown. Twigs and branches are killed. Repeated infestations may kill trees eventually. Pine needle scales may be found with black pineleaf scales, which is gray to black instead of white. The pine needle scale is a serious pest of ornamental pines and infests arborvitae, cedars, hemlock, spruces, and Douglas-fir.

For biology, life history, monitoring and management

See:

Pine (*Pinus*)—Pine needle scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Spruce (*Picea*)—Silver-spotted tiger moth

Lophocampa argentata

Pest description and damage Adult moths have a 2-inch wingspan and are brownish or tan with distinct silver-white spots on the wings. The caterpillars can reach 1.5 inches in length and are mostly reddish-brown with some blue-black or yellowish hairs. The caterpillars of the silver-spotted tiger moth feed on the needles, often "tenting" branches with dirty-looking webs. While most of the feeding occurs through fall and winter, the webs are most noticeable in the spring. Minor infestations cause little harm to trees. Douglas-fir is the preferred host, but pine, arborvitae, spruce, and true firs are also attacked.

For biology, life history, monitoring and management

See:

Douglas-fir (*Pseudotsuga*)—Silver-spotted tiger moth

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Spruce (*Picea*)—Spruce aphid

Elatobium abietinum

Pest description and damage The spruce aphid is green and only 0.05 to 0.1 inch in length at maturity. Plants affected by spruce aphid first show banded yellowish blotches on the needles, sometimes with honeydew (sticky material excreted by the aphid) present. The needles may turn completely yellow or brown and drop. New growth is not affected, leaving trees with bare centers and green tips.

Biology and life history Spruce aphids feed during the winter and early spring before new growth occurs, so affected trees may have needles only on the tips of branches later in the year. Damage is usually not apparent until after aphids have left the tree. Aphids appear early in the season (about February) and may increase rapidly during March and sometimes April. Check weekly for aphids on important trees starting about November (monitor less important trees beginning around February, depending on weather).

Management—biological control

Aphids have many natural enemies, including lady beetles, syrphid fly larvae, and lacewings. Avoid broad-spectrum insecticide applications that would disrupt these controls.

Management—cultural control

Wash aphids from plants with a strong stream of water. Aphid populations tend to be higher in plants fertilized liberally with nitrogen and heavily watered, as this produces flushes of succulent growth. Avoid excessive watering and use slow-release or organic sources of nitrogen. Control ants, which "farm" the aphids and protect them from predators so the ants can harvest their honeydew.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Spruce (*Picea*)—Spruce bud scale

Physokermes hemicryphus

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Female spruce scales are semiglobular (0.1 inch in diameter), brown or reddish, and occur at the base of new shoots. They tend to be very inconspicuous, as they may be hidden by the bark and may resemble buds. Lower branches often are infested heavily and may be killed, while upper branches are much less affected. Spruce bud scales produce a large amount of honeydew that is covered with black sooty mold.

For biology, life history, scouting, and management options

See "Scale insect" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Spruce (*Picea*)—Spruce budworm

Choristoneura occidentalis

Pest description and damage Adult moths are mottled orangish brown; wingspan is up to 1 inch. Larvae are typically green to brown with a darker head and grow to about 1 inch in length. Larvae feed on buds and foliage and tie shoot tips together with webbing to make a nest. Spruce budworm is mainly a pest of balsam and subalpine firs. Although considered a significant problem in forestry, this insect is an infrequent pest in the landscape.

For biology, life history, scouting, and management options

See:
Douglas-fir (Pseudotsuga)—Spruce budworm

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Spruce (*Picea*)—Spruce needleminer

Taniva albolineana

Pest description and damage Adult moth is dark brown with a wing expanse of 0.5 inch. The larvae are light greenish to brown and grow to approximately 0.5 inch in length. The spruce needleminer feeds on spruce needles from the inside out, starting at the base of the needle. Large amounts of webbing are around the needles. Completely mined and hollowed out needles look translucent and be cut off, sometimes resulting in severe needle loss. The spruce needleminer attacks mainly blue, Sitka, and Engelmann spruce in the western U.S.

Biology and life history The larvae overwinter in hollowed-out needles. As the weather warms, they resume feeding and pupate in mid-spring. Adult moths emerge in May and June and lay eggs on needles. When eggs hatch, each larva cuts a hole near the base of the needle and then mines the interior. There is one generation per year.

Management—cultural control

Hand-pick larvae on small trees.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

Spruce (*Picea*)—Spruce spider mite

Oligonychus ununguis

Pest description and damage Several species of spider mites can cause damage in deciduous, evergreen, and coniferous ornamentals. The appearance of these mites varies with the species, although all are 0.02 inch or smaller. Adults and nymphs can be yellowish, greenish, or reddish brown, depending on species. Female European red mites are round with red bodies; males are yellowish red. Twospotted mites are oval and yellowish-brown or green with distinctive black spots on the body. Plant is covered with fine silk webbing at branch axils or over sections, small plants may be engulfed in webbing under very heavy infestations. Mites damage leaves and fruit indirectly by feeding on leaves, which causes stippling, bronzing, and possibly leaf drop. The reduction in photosynthesis causes loss of vigor and yield.

For biology, life history, monitoring and management

See "Spider mite" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Spruce (*Picea*)—Western webspinning sawfly

Cephalcia californica

Pest description and damage Webworms are larvae of webspinning sawflies. The larvae may measure up to 1 inch in length and cause distinctive damage on spruce and some pines. The older needles on the tree are consumed, and the webworms construct a large web at the feeding site, which becomes covered with frass. The new growth on the tree may extend beyond the defoliated stems of the older growth. The adult wasp is about 0.6 inch in length and shiny blue-black with a reddish head, pronotum and legs.

Biology and life history The insect overwinters as a larva or pupa in the soil. Adults emerge in mid-spring. The females lay eggs on old needles of the tree. The larvae hatch and soon begin feeding, spinning loose webs at the base of the needles. They feed on the old growth, pulling the cut needles into the web. The larvae feed for up to three weeks. When they are mature, usually in June, they drop to the ground and form earthen cells 3 inches below the surface. There is one generation per year.

Management—biological control:

In Austria, nematodes applied to the soil gave good control if the soil pH was kept at 5.0 to 7.0 with lime applications.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

For more information

See "Sawfly" in:
Common Landscape Pests

Spruce (*Picea*)—White pine weevil

Pissodes strobi

Pest description and damage White pine weevils are brown beetles with light blotches on the highly curved back. Adults grow to about 0.25 inch in length and feed on shoots and needles of pine and spruce. The larvae feed on needles and mine shoot tips, often distorting or killing back the terminals and causing trees to appear deformed. Infested terminals often develop a "shepherd's crook" appearance. The weevil attacks eastern white pine (*Pinus strobus*), Sitka spruce (*Picea sitchensis*), and a wide variety of other pines and spruce and even Douglas-fir.

Biology and life history Adult beetles overwinter in litter on the ground. In the spring, adults walk or fly to host trees, where they settle on the leader to mate. Eggs are deposited in a cavity on the tree. The eggs hatch, and the larvae commence feeding in the bark, killing the leader. As they feed, the current season's growth is emerging, but this soon collapses, causing the characteristic "shepherd's crook." The larvae then bore into the wood to pupate. The adult beetles emerge in late summer (around mid-August into fall) and overwinter in organic debris on the ground.

Management—cultural control

Prune and destroy affected terminals in the summer before adult beetles emerge. This will help reduce next year's infestation.

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Sycamore (*Platanus*)—Aphid

Includes *Drepanosiphum platanoidis*

Pest description and damage Several species of aphids can become a problem for sycamores. Aphids tend to be small (0.0625 to 0.125 inch in length), oval to pear-shaped, soft-bodied insects with piercing-sucking mouthparts. Color varies, but most aphids tend to match host plant coloration. Aphids tend to feed in colonies and are found on the most succulent plant tissues. Feeding damage to trees is usually minor but can compromise the vigor of the host when aphid populations are high. Aphids produce honeydew that supports growth of a black sooty mold fungus. In addition to cosmetics, honeydew may become a sticky nuisance when it falls on decks, cars, or other landscape surfaces.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Sycamore (*Platanus*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inch in length, covered with yellow, rusty then black colored silky hairs. Adult moths have a 1-inch wingspan and are bright white with orange and black markings on the underside of their abdomens. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:

Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Sycamore (*Platanus*)—Sycamore scale

Stomacoccus platani

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The sycamore scale is tiny (adult length from 0.05 to 0.06 inch). This insect causes leaves to develop small yellow spots. Eventually, the leaves become pock-marked with numerous small, brown, necrotic (dead) spots that may be confused with leaf spot fungi. Leaves infested while young are often smaller and disfigured. Premature leaf fall also may occur, although other factors may cause early leaf drop. This scale species also feeds on bark, causing twig dieback.

Biology and life history The scale overwinter in crevices on the bark. Eggs are laid in late winter in cottony masses. Egg hatching coincides with leaf budbreak and continues until the leaves are expanded fully. The crawlers move from the bark to the new foliage to feed. Sycamore scales frequently align themselves along the major veins of the leaf to feed. They remain here until maturity, and then migrate back to the bark to lay eggs for a new generation. There may be three to five generations per year.

For biology, life history, monitoring and management

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Tulip (*Tulipa*)—Bulb mite

Rhizoglyphus echinopus

Pest description and damage Mature bulb mites vary in length from about 0.02 to 0.03 inch and have four pairs of legs. Their bodies are shiny, white, somewhat transparent, and smooth with reddish brown appendages. They are found in colonies. Their oval shape and sluggish behavior can deceive the human eye into identifying them as eggs. They avoid the light and hide under damaged or diseased tissue. Bulbs infested with bulb mites may rot and fail to produce new growth, or new growth may be off-color, stunted, and distorted. Although the bulb mite is not a primary pest of bulbs, it is often responsible for serious losses; the slightest injury to a bulb will allow bulb mites to enter and establish. Once the mites are inside the bulb, they rapidly turn the bulbs into rotten pulp. Injured or bruised bulbs are the most susceptible to damage. Not only do mites destroy bulb tissue, but they also carry fungi and bacteria that often spur additional damage. Bulb mites also heavily affect hyacinths and lilies. Bulbs planted too late in the season are often heavily infested and dried out by the time they are planted.

Biology and life history Bulb mites rarely are noticed as isolated individuals, but rather as large colonies. All stages of the mite are found throughout the year.

Management—cultural control

It is very important to avoid rough handling of bulbs to prevent injury that might afford an entry point for fungi and bulb mites. Bulb mites cannot withstand drought, and dry bulbs in storage usually are not attacked (unless mites are already deep inside tissue). Mites can build up on decaying vegetation. Fallow area or rotate to non-hosts if populations are high. Treat bulbs with hot water before planting.

For more information

Anon. Bulb mites. University of Florida (https://mrec.ifas.ufl.edu/Foliage/entomol/ncstate/mite2.htm)

Orloff, S., G. J. Poole.2008. Bulb mites. UC ANR Publication 3453 (https://ipm.ucanr.edu/agriculture/onion-and-garlic/bulb-mites/)

Tuliptree (Liriodendron)—Tuliptree aphid

Illinoia liriodendri

Pest description and damage Tuliptree aphids are about 0.1 inch in length, green to pinkish, elongate soft-bodied insects with long legs. They form clusters of aphids of various sizes on the undersides of the leaves, especially at the tips of branches. The terminal shoots become dull as nitrogen is removed by these sucking pests. They are noted for producing copious amounts of honeydew that coats underlying vegetation.

Biology and life history In the fall, adult aphids lay eggs tucked in crevices formed by buds and branches where they will spend the winter. At this time, adult aphids may die off. Eggs hatch at bud break and begin to feed and mature. At maturity, the parthenogenetic, unmated females give birth to live nymphs. These develop and give birth to more aphids. Winged adults that can migrate to new hosts develop in fall.

Pest monitoring Begin monitoring for aphids and biological controls in spring at budbreak.

Management—chemical control:

See "Aphid" in:
Common Landscape Pests

See Table 1 in:
Chemical Control of Landscape Pests

Viburnum (*Viburnum*)—Bean aphid

Aphis fabae

Pest description and damage Adult bean aphids are about 0.10 inch in length, soft-bodied, dark green to black insects with lighter color legs. They are found on the undersides of leaves and on new growth, often in dense colonies. Heavy aphid feeding may distort shoot tips and leaves, and leaves may turn yellow, wilt, or show other signs of stress. Typically, bean aphids produce large amounts of honeydew—a sweet, sticky material. This material can attract honeydew-feeding ants, and yellowjackets, which protect aphid colonies from predators. Honeydew is covered with a dark, unsightly growth of sooty mold. Viburnum is a winter host for this aphid, which is found on various vegetables in the summer, including beans, lettuce, and squash. The aphid does not attack *Viburnum davidii*.

For biology, life history, monitoring and management

See "Aphid" in:
Common Landscape Pests

Management—chemical control

See Table 1 in:
Chemical Control of Landscape Pests

Viburnum (*Viburnum*)—Root weevil

Black vine weevil (*Otiorhynchus sulcatus*)
Obscure root weevil (*Sciopithes obscurus*)
Strawberry root weevil (*Otiorhynchus ovatus*)

Pest description and damage Identification is important: species differ in susceptibility to pesticides and may have different life cycles. Adult weevils are dark-colored, nocturnal beetles around 0.25 inch in length, with a snout (rostrum) and elbowed antennae. In addition to the ragged notches in leaves the weevils may girdle some of the stems resulting in dead branch tips. The C-shaped, legless weevil larvae are white with tan heads, up to 0.5 inch in size. They rarely cause significant damage in established landscapes.

For biology, life history, monitoring and management

See "Root weevil" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Viburnum (*Viburnum*)—Viburnum leaf beetle

Pyrrhalta viburni

Pest description and damage Adults are brown and about 0.25 inch in length. Mature larvae are greenish-yellow and are about 0.375 inch long. The adults and the larvae both chew holes in the leaves, although the feeding damage is different. Adults chew oblong shot holes in the leaves, whereas the larvae skeletonize the leaves. The popular snowball bush, *V. opulus*, is one of the known hosts of this beetle, although it may infest other *Viburnum* species grown in the PNW.

Biology and life history Viburnum leaf beetle are a European insect that is currently restricted to northwest Washington and British Columbia in Canada. The insect overwinters as eggs. The female beetle chews square holes in the twigs and deposits the eggs, then covers them with a black cap of wood chips and excrement. The eggs hatch in the spring and the larvae feed on the young expanding leaves. Adults appear in mid-summer and seen until frost.

Management—cultural control

Individual infested twigs with overwintering eggs clusters are pruned out in the dormant season. Watch for feeding damage in the early spring and pick off or hose off the larvae.

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Willow (*Salix*)—Aphid

Includes giant willow aphid (*Tuberolachnus salignus*)

Pest description and damage **There are several species of aphids known to feed on the foliage, stems, flowers, or bark of willows. The largest of** these soft-bodied piercing-sucking insects is the giant willow aphid at 0.2 inch in length. This aphid has a dark body that appears gray due to the many hairs; it also has conspicuous dorsal tubercles. This insect forms large colonies on the bark of willow, often concentrated close to the ground. Damage seems minimal. There are other aphid species that infest willows. They vary by color patterns and preferences for feeding on bark, leaves, branches, or new growth. Some produce more honeydew and some are regularly tended by ants.

For biology, life history, monitoring and management

See "Aphid" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Willow (*Salix*)—Azalea bark scale

Eriococcus azaleae

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Azalea bark scales superficially resemble mealybugs in appearance. Mature female scales are about 0.125 inch long and appear as white cottony sacs, often located on twigs and stems of azalea, especially in branch axils. Eggs, crawlers, and scale insects under the white cotton are red.

For biology, life history, monitoring and management

See:

Azalea (*Rhododendron*)—Azalea bark scale

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Willow (*Salix*)—Willow beaked-gall midge

Rabdophaga rigidae

Pest description and damage The adult beaked-gall midge is a small black fly about 0.2 inch in length. The larvae are about 0.2 inch long when mature. The adult midge lays eggs on buds in the spring, and the larval tunneling and feeding of the larvae causes the bud to swell and harden. By summer, it develops a characteristic shape and a reddish color. Infestations rarely seriously injure a tree, but successive years of high infestations can alter the appearance of the plant, much as if the plant were excessively pruned. Pussy willow (*Salix caprea*) is reportedly a favorite host species.

Biology and life history The insect overwinters as a partly developed larva in the gall. In spring, the adults emerge, mate, and the females lay eggs

on swollen willow buds. The emerging larva tunnels into the bud and causes gall formation. The larva develops inside a hollow cavity in the gall, which by September is hardened and red. There is one generation per year.

Management—cultural control

Prune out willow-beaked galls as they are noticed. If you prune them out in the fall or winter, be sure to destroy them by crushing or burying. The adults probably will still emerge if the galls are thrown to the ground.

Management—chemical control

See Table 3 in:
Chemical Control of Landscape Pests

For more information

See "Gallmakers" in:
Common Landscape Pests

Willow (*Salix*)—Carpenterworm

Prionoxystus robiniae

Pest description and damage Carpenterworms are the larvae of a large, mottled gray and black moth whose size ranges from 1.75 to 3.0 inches in length. The caterpillars are greenish to pinkish white with a dark head and are one to three inches long when mature. The caterpillars bore into the trunk and main branches of cottonwood, ash, birch, black locust, elm, oak, maple, pear, poplar, willow, locust, and occasionally other fruit trees, shrubs and deciduous trees. Discolored or bleeding limbs, branch dieback, and lumpy or gnarled trunks may be indications of carpenterworm infestation. Typical symptoms of infestation include sawdust-like material (frass) and wood chips mixed with loose webbing on or around infested trees. Trees with severe carpenterworm infestations are susceptible to wind breakage and may need to be removed.

For biology, life history, monitoring and management

See:
Cottonwood (*Populus*)—Carpenterworm

Management—chemical control

See Table 4 in:
Chemical Control of Landscape Pests

Willow (*Salix*)—Fall webworm

Hyphantria cunea

Pest description and damage These gregarious caterpillars spin web-like tents in branch tips of deciduous trees including apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, willow, and sometimes roses and other shrubs. The caterpillars feed on enclosed leaves as the tent fills with dead leaves and frass. Young caterpillars are pale greenish or yellow with a dark stripe down the back and a yellow stripe along the sides. Long silky hairs arise from yellow and black tubercles. When mature, the caterpillars are over 1.25 inch in length, covered with rusty colored silky hairs. Adult moths have about a 1-inch wingspan and bright white with orange and black markings on the underside of the abdomen. Whitish moth scales cover masses of 200 to 500 greenish eggs.

For biology, life history, monitoring and management

See:
Cottonwood (*Populus*)—Fall webworm

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Willow (*Salix*)—Flea beetle

Alder flea beetle (*Altica ambiens*)

Pest description and damage Both adults are dark, shiny blue, and about 0.25 inch in length. Larvae are black and about 0.25 inch long at maturity. Adults chew holes in leaves while the larvae feed in groups and skeletonize foliage of alder, poplar, willow dogwood and other hosts. They are capable of defoliating trees but often they are in smaller numbers throughout the trees. As the insects look similar and often both hosts grow together, it is difficult for the non-professional to identify beetles by species.

For biology, life history, monitoring and management

See:

Alder (*Alnus*)—Alder flea beetle

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Willow (*Salix*)—Oystershell scale

Lepidosaphes ulmi

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The mature oystershell scale is approximately 0.125 inch in length, with a scale cover that is brown or gray , and usually elongated and slightly curved like an oyster or mussel shell. Oystershell scales are on trunks, branches, and twigs. They occur less frequently on the leaves and fruit. Scale infestations often are limited initially to isolated colonies on single branches or twigs. Newly emerged crawlers look like tiny bright white pimples on the bark.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Oystershell scale

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Willow (*Salix*)—Poplar-and-willow borer

Cryptorhynchus lapathi

Pest description and damage The adult poplar-and-willow borer is a black and pink to cream-colored weevil (a flightless snout beetle), about 0.375 inch in length. The larvae are white, legless, and about 0.25 inch long at maturity. Larvae feed by mining beneath the bark of trunk and branches. In late summer, feeding larvae expel large quantities of sawdust-like frass (excrement) through holes in the bark accompanied by flow of a thin sap. Larval feeding may girdle branches, resulting in breakage, leaf wilt or eventual branch death. Severe infestations cause lumpy, swollen bark, with cracks and bark scars with exposed wood. Old wood may produce large numbers of new shoots. Willows are the preferred host, but the poplar-and-willow borer also attacks poplars. The adults chew small holes in the bark of twigs and shoots, introducing a fungus that may cause shoots to wilt. This insect has become a serious problem in hybrid poplar plantations, and in willows grown for the cut flower industry and restoration plantings. In landscapes, damage is most common on native willows.

Biology and life history The adult weevils lay eggs just under the bark in the cambium, mostly near lenticel, buds and wounds in late summer and early fall. Eggs hatch soon after they are laid and begin to feed under the bark, creating a small chamber in which they hibernate over winter. They resume feeding in the cambium, then bore into the heartwood to pupate and adults emerge in late summer. It only takes one year from egg to adult, but the adults can live up to three years so that the weevils are increasing over time. This allows an accelerated buildup of this insect.

Pest monitoring Adults may be dislodged from branches by beating foliage. In spring, evidence of infestation is a sap flow down the trunk of the tree and moist sawdust pushed out of the gallery. Adults are found walking on trunks or branches, especially at night. Look also for wilting of suckers and pronounced holes in the young stems from adults feeding.

Management—cultural control

Hand-pick adults when noticed on trunk and branches. Beating may also dislodge more than are visible. Remove infested branches showing evidence of attach and dispose of the prunings in a chipper or yard waste. Do not allow wood to remain for weevils to emerge.

Management—biological control

Little is known of the effectiveness of biological control.

Management—chemical control

See Table 4 in:

Chemical Control of Landscape Pests

Willow (*Salix*)—Spiny elm caterpillar (mourning cloak butterfly)

Nymphalis antiopa

Pest description and damage The spiny elm caterpillar is the larval stage of the mourning cloak butterfly. The adult butterfly is approximately 2.5 inches across, with purplish brown to black wings bordered by a creamy yellow stripe and a row of blue spots. The larvae are purplish black with white specks and have a row of orange to red spots along the back and when mature approach 2.0 inches in length. They have brownish prolegs and are clothed with long, forked spines. The caterpillars often feed in large groups and eat all the leaves on a branch before moving. Their feeding results

in raggedly chewed leaves. Spiny elm caterpillars also feed on willow and poplar trees. They usually are not serious pests.

Biology and life history The adult butterfly overwinters in protected places and is found flying on warm spring days coinciding with budbreak. The females lay eggs in masses on twigs, and the larvae hatch and feed in large groups. After feeding, the mature larva pupates by suspending itself in a chrysalis from a leaf. The second generation, if there is one, emerges in August.

Management—biological control

There are several wasp parasites of the larvae. Birds will pursue and eat the adult butterfly.

Management—cultural control

Hand-pick larvae or remove heavily infested branches.

See "Caterpillar" in:
Common Landscape Pests

For more information

Cloyd, R.A. 2000. Spiny elm caterpillar. University of Illinois Extension (https://hyg.ipm.illinois.edu/pastpest/200007c.html)

Willow (*Salix*)—Satin moth

Leucoma salicis

Pest description and damage The adult moth (over 1-inch wingspan) is satiny white with black markings on the legs. The attractive larvae are approximately 2 inches in length when grown and reddish brown with double white dorsal patches and tufts of hairs along the sides. They can seriously skeletonize then defoliate cottonwood, poplar, and willow. They occasionally attack oak and aspen. Lombardy poplar and silver maple are particularly susceptible.

For biology, life history, monitoring, and management

See:
Poplar (*Populus*)—Satin moth

See "Caterpillar" in:
Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Willow (*Salix*)—Tent caterpillar

Forest tent caterpillar (*Malacosoma disstria*)
Western tent caterpillar (*Malacosoma californica*)

Pest description and damage The western tent caterpillar attacks a wide variety of plants including alder, ash, birch, cottonwood, and willow as well as fruit trees and roses. The adult moths are stout, light to darker brown, and are active in early- to mid-summer. The over 1-inch-long adult moths are attracted to lights at night. Mature western tent caterpillars can reach a length of about 2.0 inches and are hairy, dull yellow brown, with rows of blue and orange spots on the body. Mature forest tent caterpillars can be as long as 2.5 inches and are black and blue with dorsal white "footprints." Eggs of these moths are laid on twigs or buildings and may be especially numerous around lights. The egg masses are brown to gray in color, about 0.625 inch long, and look like bits of gray, hardened foam. The larvae of both species construct unsightly nests or "tents" in the crotches and branches of host trees. The larvae leave the tent by day to feed on foliage of host plants and may do significant damage by defoliation. The larvae usually return to the tent in the evening. Tent caterpillars can defoliate small trees. Defoliation can hinder plant growth, make the plants more susceptible to competition, diseases or poor weather and defoliation over consecutive years may weaken or kill unthrifty hosts. Healthy trees usually will grow new leaves by midsummer.

For biology, life history, monitoring and management

See:
Alder (Alnus)—Tent caterpillar

Common Landscape Pests

Management—chemical control

See Table 2 in:
Chemical Control of Landscape Pests

Witch-hazel (*Hamamelis*)—Root weevil

Includes
Black vine weevil (*Otiorhynchus sulcatus*)
Clay-colored weevil (*Otiorhynchus singularis*)
Strawberry root weevil (*Otiorhynchus ovatus*)

Pest description and damage Adult weevils are dark colored, nocturnal beetles about 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Look for ragged notches on the edges of leaves or flower petals.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Yew (*Taxus*)—Cottony camellia scale

Pulvinaria floccifera

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. The most visible stage of the cottony camellia scale is the adult female insect beneath a scale that resembles a flat 0.125-inch diameter cover often found on the underside of a leaf. Emerging from beneath the adult female scale is an oblong cottony white egg mass that can be up to twice the length of the adult scale. The cottony camellia scale (sometimes called taxus scale) crawlers are flat brownish or yellowish sucking insects. Foliage with scale infestations may turn yellowish or pale in color. Due to copious honeydew, leaves below are covered with a crust of black sooty mold. The cottony camellia scale is also in camellia and many other hosts. On yew, it is known as the cottony yew scale. It is possible to have low numbers of this insect for years without an outbreak.

For biology, life history, monitoring and management

See:

Camellia (*Camellia*)—Cottony camellia scale

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Yew (*Taxus*)—False spider mite

Pentamerismus taxi

Pest description and damage These mites are small (0.01 inch in length), deep red, small, short-legged mite generally flattened in shape. These mites are at the base of needles, often in considerable numbers. They are on yew but also may occur on other evergreens.

Biology and life history Most mite species share a similar life cycle. Most of this species overwinters as eggs on host plants, although some may overwinter as adult females. Mites become active in the spring. There may be eight to ten overlapping generations per year.

Pest monitoring Observe the leaves for mites and webbing and check for the number of pest and predator mites. Sufficient biological control is achieved by midsummer.

Management—biological control

Phytoseiid predator mites always keep mites under control if broad-spectrum insecticide applications are avoided. Insect predators of mites include lady beetle adults and larvae, thrips, and pirate bugs. Heavy rain and cold weather also suppress mite numbers.

Management—cultural control

Elimination of broadleaf weeds such as mallow, bindweed, white clover, and knotweed with cultivation or grasses may reduce mite numbers. Wash mites from the tree with a strong stream of water. This also dislodges dust and dirt, which favor an increase in mite numbers. Water trees properly, as drought-stressed trees are more susceptible. Avoid excessive nitrogen applications, as this encourages mites.

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Yew (*Taxus*)—Lecanium scale

Includes *Parthenolecanium corni*

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Lecanium scales are most noticeable as the female scales expand in size in the spring. As females swell in the spring, they produce large egg masses under the scale and release considerable honeydew that coats nearby foliage. The female lecanium scales are about 0.125 inch in diameter and vary from red to dark brown in color. They are oval and raised, resembling small "helmets," "turtles," or bumps on branches, stems, and the underside of leaves. Male scales are smaller, flat, and oblong. Crawlers are pale yellow and overwinter on stems of host plant.

For biology, life history, monitoring and management

See:

Ash (*Fraxinus*)—Lecanium scale

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Yew (*Taxus*)—Root weevil

Includes
Black vine weevil (*Otiorhynchus sulcatus*)
Clay-colored weevil (*Otiorhynchus singularis*)
Strawberry root weevil (*Otiorhynchus ovatus*)

Pest description and damage Adult weevils are dark colored, nocturnal beetles about 0.25 inch in length, with a snout (rostrum) and elbowed antennae. Most of the species are all females and capable of laying eggs after a period of feeding to mature their ovaries. Larvae, found around roots of yew, are C-shaped, legless, and white with tan heads, up to 0.5 inch in size. Check base of unthrifty shrubs for root or crown girdling by larvae. This is especially important in new plantings. The larvae of all species are quite similar in appearance and habit: feeding on root hairs, larger roots, and root crown. Look for notches in needles. Dead tips scattered in plants where weevils have girdled the twigs are common.

For biology, life history, monitoring and management

See "Root weevil" in:

Common Landscape Pests

Management—chemical control

See Table 2 in:

Chemical Control of Landscape Pests

Yew (*Taxus*)—Spruce bud scale

Physokermes piceae

Pest description and damage Scale insects are small (less than 0.125 inch in length) soft insects that live beneath waxy scales. These insects are often identified by the shape and size of their scales, the description of adult males and females, immature crawler stage, color of eggs, and host plant preferences. Female spruce bud scales are semiglobular (roughly 0.3 inch in diameter), brown or reddish, and occur at the base of new shoots. They tend to be very inconspicuous, as they may be partly hidden by the bark and may resemble buds. Lower branches are infested heavily and may be killed, while upper branches are much less affected. The spruce bud scale produces a large amount of honeydew that is covered with black sooty mold. They infest various species of yew, and Alberta and Norway spruce.

For biology, life history, monitoring and management

See:

Spruce (*Picea*)—Spruce bud scale

See "Scale insect" in:

Common Landscape Pests

Management—chemical control

See Table 1 in:

Chemical Control of Landscape Pests

Turfgrass Pests

Gwen Stahnke, and Alec Kowalewski, Dani Lightle, and Zach Hamilton

Latest revision—March 2024

INCLUDES MANAGEMENT OPTIONS FOR COMMERCIAL AND HOME USE

In all cases, follow the instructions on the pesticide label. The *PNW Insect Management Handbook* has no legal status, whereas the pesticide label is a legal document. Read the product label before making any pesticide applications.

Protect pollinators: See How to Reduce Bee Poisoning from Pesticides.

Note: Products are listed in alphabetical order and *not* in order of preference or superiority of pest control.

Turfgrass—Ant

Various species

Pest description and crop damage Ants normally establish their colonies in sunny locations in well-drained soils. In turf, a nest consists of a series of underground tunnels and galleries which may extend three or more feet beneath the soil surface. Multiple openings provide access to the surface. During nest construction, ants excavate large quantities of soil which they deposit in mounds on the surface. Not only are these mounds unsightly, but they can smother the turfgrass immediately surrounding colony openings and make routine maintenance difficult by producing a bumpy, uneven turf.

See also

Turfgrass—Harvester ant

Biology and life history A typical ant colony consists of an egg-laying queen, males, immature stages (eggs, larvae and pupae) and hundreds to thousands of sterile female workers which can become a nuisance as they forage around buildings, sidewalks, foundations and driveways. Ants consume a wide variety of foods including seeds, small insects, plant sap, flower nectar and fungal growth. Many ant species feed on honeydew, a sweet liquid secreted by plant-feeding insects such as aphid, mealybugs, scale insects and leafhoppers. In the spring and fall, colonies produce winged ants that leave the colony, mate and seek new nesting sites.

Management—chemical control: HOME USE

Effective ant control normally requires destruction of the queen. In most cases, this necessitates one or more applications of a liquid or granular insecticide. In situations where only a few colonies are present, apply insecticides directly to colony openings and the areas immediately surrounding the mounds.

- abamectin
- azadirachtin (neem oil)—Some formulations are OMRI-listed for organic use.
- *Beauvaria bassiana*—Some formulations are OMRI-listed for organic use.
- beta-cyfluthrin (as a mix with imidacloprid)
- bifenthrin (often as a mix with other ingredients)
- boric acid
- carbaryl
- clothianidin (as a mix with pyriproxyfen)
- cyfluthrin
- cypermethrin
- deltamethrin
- fenvalerate
- gamma-cyhalothrin
- imidacloprid
- indoxacarb
- lambda-cyhalothrin
- permethrin

- plant essential oils (cedarwood, clove, garlic, lemongrass, etc.)—Some formulations are OMRI-listed for organic use.
- pyrethrins—Some formulations are OMRI-listed for organic use.
- spinosad—Some formulations are OMRI-listed for organic use.

Management—chemical control: COMMERCIAL USE

Effective ant control normally requires destruction of the queen. In most cases, this necessitates one or more applications of a liquid or granular insecticide. In situations where only a few colonies are present, apply insecticides directly to colony openings and the areas immediately surrounding the mounds.

- abamectin (Abathor Granular Ant Bait)
- azadiractin (Azaguard Botanical Insecticide/Nematicide)
- beta-cyfluthrin (Tempo SC Ultra Insecticide) at 0.001 to 0.002 lb ai/1,000 sq ft)
- bifenthrin + carbaryl (Andersons Golf Prod Duocide Insect Control)
- bifenthrin (Talstar Select Insecticide) at 0.05 to 0.1 lb ai/A. PHI 30 days. REI 12 hr. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply bifenthrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. Do not apply if rain is expected within 24 hours or whatever time is necessary for product to dry.
- boric acid (Motherearth Granular Scatter Bait)—Some formulations are OMRI-listed for organic use.
- carbaryl (Sevin SL Carbaryl Insecticide)
- cyfluthrin (Tempo 20WP Golf Course Insecticide in WSP, Tempo 20 WP Insecticide)
- cypermethrin (Demon WP Insecticide)—Highly toxic to fish.
- deltamethrin (Deltagard G Insecticide, D-Fense SC Insecticide)
- dinotefuran (Zylam)—Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- esfenvalerate + prallethrin + piperonyl butoxide (Onslaught FastCap Spider and Scorpion Insecticide)
- gamma-cyhalothrin (Scion Insecticde, Optimate CS)
- indoxacarb (DuPont Provaunt Insecticide, Provaunt Insecticide)
- lambda-cyhalothrin (Scimitar) at 5 to 10 fl oz/A (0.034 to 0.068 lb ai/A). Apply at 7-day intervals if treatment is necessary. Do not apply more than 0.36 lb of ai (52.4 fl oz of concentrate) per acre per year.
- lambda-cyhalothrin+ thiamethoxam (Tandem Insecticide)
- mint oil, geraniol + oil of rosemary (Keyplex Ecotrol Plus Insecticide/Miticide, Essentria IC3 Insecticide)—OMRI-listed for organic use.
- spinosad (Brandt Antixx)
- spinosad + iron phosphate (Bulls-eye Outdoor Granular Ant Bait)

Turfgrass—Billbug

Includes
Bluegrass billbug (*Sphenophorus parvulus*)
Denver billbug (*S. cicatristriatus*)
Hunting billbug (*S. venatus*)
Phoenician billbug (*S. phoeniciensis*)

Pest description and crop damage Adults are about 0.375 inch long, black, with a distinct snout. They lay eggs in late spring. Larvae are white with a brown head, no visible legs, and about 0.25 inch long when mature (much smaller than Japanese beetle and European chafer larvae). Larvae generally reach damaging size by midsummer. Larvae feed on grass roots. Damage often shows up as irregular patches of drought-stressed turf that is not anchored or rooted to the soil. Kentucky bluegrass and annual bluegrass is most commonly attacked by billbug larvae. However, tall fescue, perennial rye, and chewings fescue are also susceptible. Billbugs classically cause problems in eastern Oregon, central Washington and Idaho—especially around Ontario-Baker City and Boise-Twin Falls—and also occasionally from La Grande into the Columbia Gorge. More recently billbug damage has been observed in the Portland and Eugene, as well as the Seattle/Tacoma areas.

Biology and life history Bluegrass billbugs overwinter as adults. Eggs are laid on grass stems in May or June and hatch in about 2 weeks. As the larvae mature, they move from the crown of the plant into the soil where they feed on roots. There is one generation per year. The Denver and hunting billbugs have a similar life cycle but may lay eggs for a longer period of time resulting in larvae that overwinter in the soil. Damage from these species can occur much earlier in spring than damage from bluegrass billbug. Perennial ryegrasses, fine fescues, and tall fescues with high levels of endophytic fungi are resistant to billbugs.

Scouting and Action Threshold Scouting for billbugs should begin in the early summer (June and July) before damage occurs in the summer months. Scout in the top 2 inches of the soil using a shovel. The action threshold for well-maintained turfgrass is 10 to 20 larvae per sq ft.

Management—biological control

- beneficial nematodes—Read label carefully for application procedures, timing and appropriate soil temperatures for best efficacy.

Management—chemical control: HOME USE

Treat the entire lawn, not just affected areas. Spring applications when adults first become active may prevent larval populations from building to damaging levels. Do not permit children or pets on the treated lawn until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/ flowers in lawns: mow and remove clippings prior to applying insecticides.

- azadiractin (as a mix with pyrethrins)—Some formulations are OMRI-listed for organic use.
- bifenthrin (may be a mix with other active ingredients)
- carbaryl
- chlorantraniliprole
- deltamethrin
- fenvalerate
- gamma-cyhalothrin
- imidacloprid
- lambda-cyhalothrin
- permethrin
- plant essential oils (clove, mint, peppermint, etc.)—Some formulations are OMRI-listed for organic use.

Management—chemical control: COMMERCIAL USE

Where the label allows, treat the entire turfgrass stand, not just affected areas. Some active ingredients target adults, while others target larvae; choose an active ingredient compatible with the treatment timing. Spring applications when adults first become active may prevent larval populations from building to damaging levels. Do not permit children or pets on the treated turfgrass until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/ flowers in lawns: mow and remove clippings prior to applying insecticides.

- azadiractin (Azaguard Botanical Insecticide/Nematicide, Neemix 4.5 IGR)—Some formulations are OMRI-listed for organic use.
- Beauvaria bassiana GHA (Botanigard ES, Botanigard 22WP)—Some formulations are OMRI-listed for organic use.
- beta-cyfluthrin (Tempo SC Ultra Insecticide)—Not for use on golf course turf.
- bifenthrin (Talstar S Select Insecticide)—Restricted use. Apply at 0.05 to 0.1 lb ai/A. PHI 30 days. REI 12 hr. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply bifenthrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. Do not apply if rain is expected within 12 hr or whatever time is necessary for product to dry.
- bifenthrin + imidacloprid (Allectus GC SG Insecticide)—Restricted use. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply or allow to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- carbaryl (Sevin SL Carbaryl Insecticide)—Carbaryl is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply carbaryl or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area.
- chlorantraniliprole (Acelepryn Insecticide, Acelepryn G Insecticide)—For larvae at 0.1 to 0.2 ai lb/A. Max rate per treatment 0.25 lb ai/A and maximum 0.5 lb ai/A per year in broadcast applications in turf.
- clothianidin (Arena 0.25G Insecticide, Arena 50 WDG Insecticide)—For adults or larvae. Do not apply while bees are foraging. Do not apply to plants that are flowering. Only apply after all flower petals have fallen off. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- clothianidin + bifenthrin (Aloft GC G Insecticide, Aloft GC SC Insecticide, Aloft LC G Insecticide, Aloft LC SC Insecticide)—Restricted use. Not for use on golf course turf. Do not apply while bees are foraging. Do not apply to plants that are flowering. Only apply after all flower petals have fallen off. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- cyantraniliprole (Ference)—Apply when adult billbugs first observed.
- cyfluthrin (Tempo Ultra WP Insecticide, Tempo 20WP Golf Course Insecticide in WSP)—For adults.
- deltamethrin (Deltagard G Insecticide, D-Fense SC Insecticide)—For adults. Not for use on golf course turf.
- dinotefuran (Zylam)—Do not apply while bees are foraging. Do not apply to plants that are flowering. Only apply after all flower petals have fallen off. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- esfenvalerate + prallethrin + piperonyl butoxide (Onslaught FastCap Spider and Scorpion Insecticide)—Not for use on golf course turf.
- imidacloprid (Mallet 2F T&O Insecticide, several other trade names)—For larvae. Do not apply while bees are foraging. Do not apply to plants that are flowering. Only apply after all flower petals have fallen off. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- gamma-cyhalothrin (Scion Insecticide)—Highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply or allow to drift to blooming crops or weeds if bees are visiting the treatment area.
- lambda-cyhalothrin (Scimitar)—Restricted use. For adults. 10 fl oz/A, 0.034 lb to 0.068 lb ai/A. Apply at 7-day intervals if treatment is necessary. Do not apply more than 0.36 lb of ai (52.4 fl oz of concentrate) per acre per year.
- mint oil, geraniol + oil of rosemary (Furious Insecticide)—OMRI-listed for organic use.
- permethrin
- tetraniliprole (Tetrino)—For larvae at 16-32 oz/A, applied when adults are observed to control larvae for 3+ months. Maximum yearly rate is 64 oz/A.
- thiamethoxam (Meridian 0.33G, Meridian 25WG)—Apply up to second instar larvae. Irrigate following application. Highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply or allow to drift to blooming crops or weeds if bees are visiting the treatment area. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties

(check with local authorities).

- trichlorfon (Dylox 420 SL)—For larvae.

Turfgrass—Chinch bug

Blissus spp. (An as yet unidentified species, not *B. leucopterus*, the destructive species in the Midwest)

Pest description and crop damage Small black bug, 0.18 inch long, with characteristic white marks on wing covers. Nymphs are reddish with white or black markings. Chinch bugs are Hemipterans and as such have piercing, sucking mouth parts. They suck sap from the crown and stem of grasses. Because chinch bugs tend to aggregate, damage often occurs in clumps. Grass becomes yellow and dies. Chinch bug damage generally is from mid- to late summer. Lawns under moderate to severe drought stress often are affected severely, and so chinch bug damage is usually worst after a particularly warm summer. Shaded areas of turf are damaged noticeably less.

Biology and life history The species of chinch bug responsible for damage to turfgrass in the west is not well understood. The hairy chinch bug (*B. leucopterus hirtus*), which causes damage in northeastern states from Virginia to Minnesota and the southern chinch bug (*B. insularis*), found from the Carolinas to southern California, are better described. The species found in Oregon is unofficially known as the western chinch bug to differentiate it from these two. The western chinch bug is thought to have one generation per year. They likely overwinter as adults. They become active in spring when temperatures reach 45°F. Eggs are laid, which depending on temperature may hatch in 7 days or up to 6 weeks. The five immature (nymphal) stages are usually completed in 4 to 6 weeks.

Scouting and thresholds Chinch bugs are small, so are difficult to see unless you find a large population. The best places to look are where turf is damaged, good areas to look are on mounds, south-facing slopes, turf on the south side of buildings or any turf prone to drought stress.

Management—biological control

Fungal endophytes in grass, particularly in perennial ryegrass, reduce hairy chinch bug nymph survival.

Management—cultural control

Chinch bugs are not consistent pests. While conditions suitable for damage occur each year in the PNW, the last major outbreak occurred in 1985. They are not likely to damage vigorous, well-irrigated turfgrass stands. Heavily fertilized turfgrass areas are more susceptible. The most resistant turfgrasses are those that are lightly fertilized and regularly irrigated. Turfgrasses such as perennial ryegrass and fine and tall fescues with high levels of endophytic fungi are resistant to chinch bugs.

Management—chemical control: HOME USE

Do not permit children or pets on the treated turfgrass until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/flowers in lawns: mow and remove clippings prior to applying insecticides.

- azadiractin (as a mix with other active ingredients)—Some formulations OMRI-listed for organic use.
- bifenthrin (often as a mix with other active ingredients)
- carbaryl
- chlorantraniliprole
- clothianidin (as a mix with pyriproxyfen)
- deltamethrin
- fenvalerate
- imidacloprid
- lambda-cyhalothrin
- plant essential oils (cedarwood, clove, mint, rosemary, etc.)—Some formulations are OMRI-listed for organic use.
- pyrethrins—Some formulations are OMRI-listed for organic use.
- spinosad (as a mix with insecticidal soap)—Some formulations are OMRI-listed for organic use.

Management—chemical control: COMMERCIAL USE

Do not permit children or pets on the treated turfgrass until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/ flowers in lawns: mow and remove clippings prior to applying insecticides.

- azadiractin (Azaguard Botanical Insecticide/Nematicide Neemix 4.5 IGr)—Some formulations are OMRI-listed for organic use.
- *Beauvaria bassiana* GHA (Botanigard ES, Botanigard 22WP)—Some formulations are OMRI-listed for organic use.
- beta-cyfluthrin (Tempo SC Ultra Insecticide)
- bifenthrin (Talstar S, Select Insecticide, multiple label names) at 0.05 to 0.1 lb ai/A. PHI 30 days. REI 12 hr. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply bifenthrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. Do not apply if rain is expected within 24 hr or whatever time is necessary for product to dry.
- carbaryl (Sevin Brand RP4 Carbaryl, Lebanon Sevin 7G Granular Insect Control, Sevin SL Carbaryl Insecticide)
- chlorantraniliprole (Acelepryn Insecticide, Acelepryn G Insecticide)—Suppression of chinch bugs only.
- clothianidin (Arena 0.25G Insecticide, Arena, 50 WG Insecticide, Arena 50 WDG Insecticide)—Apply as soon as overwintering adults are seen in the spring. **Note**: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).

- clothianidin + bifenthrin (Aloft GC G Insecticide, Aloft GC SC Insecticide, Aloft LC G Insecticide, Aloft LC SC Insecticide)—Restricted use.
- cyantraniprole (Exirel WG)
- cyfluthrin (Tempo 20WP Golf Course Insecticide in WSP, Tempo 20 WP Insecticide)
- cypermethrin (Demon WP Insecticide)—Highly toxic to fish.
- deltamethrin (Deltagard G Insecticide, D-Fense SC Insecticide, Suspend SC Insecticide)—For adults.
- dinotefuran (Zylam)—For suppression only. **Note**: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- imidacloprid (Adonis 2F Insect Conc., AmTide Imidacloprid, Avatar PLX Insecticide, Lesco Bandit 0.5G Granular Insecticide, Lesco Bandit 2F Insecticide, Lesco Bandit 75 WSP Insecticide, Malice 0.5G, Malice 2F Insecticide, Malice 75WSP, Mallet 0.5G Insecticide, Mallet 2F Insecticide, Mallet 2F T&O Insecticide Mallet 75 WSP Insecticide, Mallet 7.1% PF Insecticide, Merit 0.5G Insecticide, Merit 2F Insecticide, Merit 75WP Insecticide, Merti 75WSP Insecticide, Midash 2SC T&O, Prokoz Zenith 0.5G Insecticide, Prokoz Zenith 2F Insecticide, Quali-Pro Imidacloprid 0.5G, Quali-Pro Imidacloprid2F T&O, Quali-Pro Imidacloprid 75 WSB Insecticide in WSP)—**Note:** Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- lambda-cyhalothrin (Scimitar, Demand CS Insecticide, Demand EZ Insecticide, Demand G Insecticide, Cyonara 9.7 Insecticide, Cyzmic CS Controlled Release Insecticide, Exile 9.7, Patrol Insecticide)
- mint oil, geraniol + oil of rosemary (Keyplex Ecotrol Plus Insecticide/Miticide, Essentria IC3 Insecticide)—OMRI-listed for organic use.
- prallethrin (ETOC)
- spinosad A & D (Conserve SC Turf & Ornamental Insect Control)—Some formulations are OMRI-listed for organic use.
- tetraniliprole (Tetrino) at 16 to 32 oz/A, applied when nymphs are observed. Maximum yearly rate is 64 oz/A.
- trichlorfon (Dylox 6.2 Granular, Dylox 420 SL Turf & Ornamental)

Turfgrass—Crane fly

European crane fly (*T. paludosa*)

Pest description and crop damage European crane fly (ECF) is a native of western Europe which was introduced to eastern Canada and found in British Columbia in 1965. The mild winters, cool summers and relatively abundant rainfall in the PNW is ideal habitat for this insect and its range now extends as far south as central California. It has been documented east of the Cascades in Spokane WA and Bend, OR. The adult is a large two-winged fly that is often compared to a large mosquito. ECF have one generation per year. The larvae are wormlike, with leathery skin, 1 to 1.5 inches long. Larvae hatch in late summer (Aug.–Sept.) and feed through winter and into spring, causing the most damage in the spring (April and May). European cranefly larvae feed on turfgrass shoots, crowns, and roots. Affected turf areas often thin out severely in early spring when normal turf starts vigorous growth. Starlings and other birds are attracted to affected turf and may damage it as they search for larvae.

Biology and life history ECF overwinters as a third-instar larva in the soil. Adult emergence may begin anytime from July to mid-October. Adult males are 14 to 19 mm long, adult females are 19 to 25 mm long. Adult crane flies do not feed—they only drink water—and their life expectancy is 2 to 14 days. They usually mate and lay eggs within 24 hours of emergence. Eggs are laid in turfgrass. Eggs and early instar larvae require a very moist atmosphere or high mortality will occur; therefore, populations are greatest in turfgrass adjacent to saturated soils. Eggs hatch in approximately 11 to 15 days. The young larvae develop rapidly through to the third instar, known as leatherjackets, in which state they overwinter. At this stage the larvae feed on the turfgrass through the winter months into the spring, causing the most damage in the spring months of April and May.

Scouting and thresholds Monitor turf areas starting in November. A common clue that ECF are present is a high level of bird activity on the turf. Scout in the top 2 inches of the soil using a shovel. The action threshold for well-maintained turfgrass is 25 larvae per sq ft.

Management—cultural control

Observations indicate that drought stress at the time of egg lay may significantly reduce larval populations. In the Willamette valley of Oregon, turning off turf irrigation systems shortly after Labor Day will often create enough drought stress to reduce larval populations without causing damage to turf. Unfortunately, around Labor Day is when most of the overseeding and seeding of new lawns is done. If there has been a history of a high population of ECF larvae in the past on your newly seeded site, it would be advisable to apply a preventative application at the time of seeding to limit the feeding of ECF larvae on the newly developing grass plants.

Management—biological control

Research indicates larvae are not affected by endophytic fungi common in some varieties of perennial ryegrass, fine fescue, and tall fescue. Research in the PNW has indicated limited efficacy of beneficial nematodes (55% reduction in larvae at best). Applied biological controls in general have not been shown to be effective on this pest, although birds and mammals such as raccoons and skunks may be highly effective.

- beneficial nematodes—Nematodes may only achieve 50% control, but this may be an acceptable level of control in some situations. Read label carefully for application procedures, timing and appropriate soil temperatures for best efficacy.

Management—chemical control: HOME USE

Do not permit children or pets on the treated turfgrass until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/ flowers in lawns: mow and remove clippings prior to applying insecticides.

- azadiractin (as a mix with other active ingredients)—Some formulations OMRI-listed for organic use.
- bifenthrin (often as a mix with other active ingredients)
- carbaryl
- chlorantraniliprole

- clothianidin (as a mix with pyriproxyfen)
- fenvalerate
- imidacloprid
- indoxacarb
- lambda-cyhalothrin
- plant essential oils (cedarwood, clove, mint, rosemary, etc.)—Some formulations are OMRI-listed for organic use.
- pyrethrins (as a mix with insecticidal soap)—Some formulations are OMRI-listed for organic use.

Management—chemical control: COMMERCIAL USE

When pest densities exceed thresholds, apply insecticides in the spring. Where serious prior infestations have occurred or when spring applications were missed, apply in mid-November to December. Most applications need irrigation or rainfall after treatment to get the insecticide to the thatch/soil interface layer where larvae are present. Do not permit children or pets on the treated turfgrass until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/ flowers in lawns: mow and remove clippings prior to applying insecticides.

- azadiractin (Azaguard Botanical Insecticide/Nematicide)—For early larval instages in early fall for best results. OMRI-listed for organic use.
- bifenthrin (Talstar S Select Insecticide, multiple trade names)—Restricted use. Not all labels allow for applications to golf courses. Treatments should be timed from August to February; applications to late season larvae may provide suppression only. Mow the lawn first and remove the clippings. REI 12 hr. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply bifenthrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. Do not apply if rain is expected within 24 hr or whatever time is necessary for product to dry.
- bifenthrin + imidacloprid (Allectus GC SC Insecticide)—Restricted use. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply or allow to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- bifenthrin + zeta-cypermethrin (Talstar XTRA Granular)—Not for use on golf course turf. Treatments should be timed from August to February; applications to late season larvae may provide suppression only.
- carbaryl (Sevin SL Carbaryl Insecticide, other trade names)—Treatments should be timed to early spring (April). Mow the lawn first and remove the clippings. Highly toxic to bees. Keep children and pets off the lawn until it has been thoroughly watered after treatment, and the grass is completely dry.
- chlorantraniliprole (Acelepryn Insecticide, Acelepryn G Insecticide)—Apply between September and November.
- clothianidin (Arena 0.25G Insecticide, Arena, 50 WG Insecticide, Arena 50 WDG Insecticide)—Apply in spring when larvae are mature bug prior to pupation, or apply in fall prior to egg hatch. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- clothianidin + bifenthrin (Aloft GC SC Insecticide, Aloft LC G Insecticide, Aloft LC SC Insecticide)—Restricted use. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply or allow to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- cyantraniliprole (Ference)—Apply between mid-summer and fall.
- dinotefuran (Zylam)—Apply in spring when larvae are mature but prior to pupation, or apply in fall prior to egg hatch. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- esfenvalerate + prallethrin + piperonyl butoxide (Onslaught FastCap Spider and Scorpion Insecticide) - Not for use on golf course turf.
- imidacloprid (Avatar PLX Insecticide, Lesco Bandit 2F Insecticide, Malice 0.5G, other trade names)—Apply at oviposition (Early September) for best results. Applications made later will not be successful. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- indoxacarb (Provaunt)—Restricted use.
- lambda-cyhalothrin (Scimitar, other trade names)—Better results when applied at earlier instars. Not as effective as bifenthrin at later larval stages.
- thiamethoxam (Meridian 0.33G Insecticide, Meridian 25WG Insecticide, Flagship 25WG Insecticide)—Effective only when applied at oviposition. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).

For more information: Cranefly pests of the PNW—http://whatcom.wsu.edu/cranefly/index.htm

Turfgrass—Cutworm

Primarily
Black cutworm (*Agrotis ipsilon*)
Glassy cutworm (*Apamea devastator*)
Variegated cutworm (*Peridroma saucia*)
Winter cutworm (*Noctua pronuba*)

Pest description and crop damage Adult cutworms are medium to large moths but all damage is due to larval feeding. Larvae are typically 1 to 1.5

inches long. Winter cutworm have black dashes that run the length of the larvae, bordered by a cream-yellow line. Winter cutworm also have a tan head with 2 black arcs on the eyes. The black cutworm is light gray to almost black in color, with a greasy appearing texture and coarse granules of various size on the skin. The glassy cutworm larvae are glossy, semi-translucent with a greenish-white or grey body lacking body markings, and a prominent reddish-brown head. The variegated cutworm has a series of 4 to 7 small, yellow dorsal spots and the terminal (most posterior) body segment has a transverse yellow line and a black 'W', which is most evident on mature larvae. Winter cutworm and black cutworm are more common turfgrass pests than the glassy and variegated cutworm. Larval cutworm populations build as the summer progresses and damage typically occurs in the late fall or early winter when turfgrass growth slows, but larvae continue to feed on the turfgrass. Birds will also disrupt the turfgrass surface while feeding on the insects in the fall. Black cutworm feed on turfgrass maintained at a low height (greens and fairways) while winter cutworm feed on turfgrass in higher cut areas (lawns, sports fields, and golf course roughs).

Biology and life history Both winter cutworm and black cutworm overwinter as larvae and adults emerge throughout the spring and summer–May to August. In areas where spring adult emergence is observed (coastal Pacific Northwest), multiple generation per year are likely. Eggs are laid on host plants, and hatch after a few days. Young larvae feed only on foliage, although mature larvae develop a subterranean habit and may cut off plants at the surface and feed on them in their burrows. If the lawn has been aerated, cutworm larvae may be found in the late summer and fall in these holes and damage is apparent around them.

Scouting and Thresholds Scouting for larvae should begin in the summer (June) and continue to the onset of cold weather (October). The action threshold for well-maintained turfgrass is 4 larvae per sq ft. Scout using a tablespoon of lemon scented dish soap in a five-gallon bucket of water. Apply the mixture and wait for 5 minutes. Larvae will emerge from the soil and thatch trying to escape the dish soap application.

Management—biological control

Birds can often assist in control since they will pluck them from the turf, although this in itself may be damaging to turf.

- *Bacillus thuringiensis*—Some formulations are OMRI-listed for organic use.
- beneficial nematodes—Read label carefully for application procedures, timing and appropriate soil temperatures for best efficacy.

Management—Chemical control: HOME USE

Do not permit children or pets on the treated turfgrass until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/ flowers in lawns: mow and remove clippings prior to applying insecticides.

- azadirachtin (as a mix with pyrethrins)—Some formulations are OMRI-listed for organic use.
- bifenthrin (often as a mix with other active ingredients)
- carbaryl
- chlorantranilprole
- clothianidin (as a mix with pyriproxyfen)
- cyfluthrin
- gamma-cyhalothrin
- imidacloprid
- lambda-cyhalothrin
- plant essential oils (clove, garlic, thyme, etc.)—Some have demonstrated efficacy against Lepidopteran larvae. Some formulations are OMRI-listed for organic use.
- spinosad (as a mix with insecticidal soap)—Some formulations are OMRI-listed for organic use.

Management—Chemical control: COMMERCIAL USE

Do not permit children or pets on the treated turfgrass until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/ flowers in lawns: mow and remove clippings prior to applying insecticides.

- acephate (Orthene Turf Tree & Orn. WSP)
- azadiractin (Azasol, Azatin, Azaguard Botanical Insecticide/Nematicide, Neemix 4.5 IGR)—Some formulations are OMRI-listed for organic use.
- beta-cyfluthrin (Tempo SC Ultra Insecticide,)
- bifenthrin (S, Select Insecticide, multiple label names) at 0.05 to 0.1 lb ai/A. PHI 30 days. REI 12 hr. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply bifenthrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. Do not apply if rain is expected within 24 hr or whatever time is necessary for product to dry.
- bifenthrin + imidacloprid (Allectus G Insecticide)—**Note**: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- capsaicin + allyl isothiocyanate (Dazitol Concentrate)
- carbaryl (Sevin Brand RP4 Carbaryl, Lebanon Sevin 7G Granular Insect Control, Sevin SL Carbaryl Insecticide)
- chlorantraniliprole (Acelepryn Insecticide, Acelepryn G Insecticide)
- clothianidin (Arena 0.25G Insecticide, Arena, 50 WG Insecticide, Arena 50 WDG Insecticide)—Apply as soon as overwintering adults are seen in the spring. **Note:** Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- clothianidin + bifenthrin (Aloft GC G Insecticide, Aloft GC SC Insecticide, Aloft LC G Insecticide, Aloft LC SC Insecticide)—Restricted

use.

- cyfluthrin (Tempo 20WP Golf Course Insecticide in WSP, Tempo 20 WP Insecticide)
- deltamethrin (Deltagard G Insecticide, D-Fense SC Insecticide, Suspend SC Insecticide)—For adults.
- dinotefuran (Zylam)—**Note**: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- esfenvalerate + prallethrin + piperonyl butoxide (Onslaught FastCap Spider and Scorpion Insecticide)
- gamma-cyhalothrin (Scion Insecticide, Optimate CS)
- imidacloprid (Adonis 2F Insect Conc., AmTide Imidacloprid, Avatar PLX Insecticide, Lesco Bandit 0.5G Granular Insecticide, Lesco Bandit 2F Insecticide, Lesco Bandit 75 WSP Insecticide, Malice 0.5G, Malice 2F Insecticide, Malice 75WSP, Mallet 0.5G Insecticide, Mallet 2F Insecticide, Mallet 2F T&O Insecticide Mallet 75 WSP Insecticide, Mallet 7.1% PF Insecticide, Merit 0.5G Insecticide, Merit 2F Insecticide, Merit 75WP Insecticide, Merti 75WSP Insecticide, Midash 2SC T&O, Prokoz Zenith 0.5G Insecticide, Prokoz Zenith 2F Insecticide, Quali-Pro Imidacloprid 0.5G, Quali-Pro Imidacloprid2F T&O, Quali-Pro Imidacloprid 75 WSB Insecticide in WSP)—For larvae. **Note**: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- indoxacarb (DuPont Provaunt Insecticide, Provaunt Insecticide)—For larvae.
- mint oil, geraniol + oil of rosemary (Keyplex Ecotrol Plus Insecticide/Miticide, Essentria IC3 Insecticide)—OMRI-listed for organic use.
- spinosad A&D (Conserve SC Turf & Ornamental Insect Control)—For larvae. Some formulations are OMRI-listed for organic use.
- tetraniliprole (Tetrino)—For larvae at 16 to 32 oz/A, will provide 8 to 14 weeks of control depending on rate. Maximum yearly rate is 64 oz/A.
- trichlorfon (Dylox 6.2 Granular, Dylox 420 SL Turf & Ornamental)—For larvae.

Turfgrass—Sod webworm

Includes
Cranberry girdler (*Chrysoteucia topiaria*)
Larger sod webworm (*Pedasia trisecta*)

Pest description and crop damage The larger sod webworm (LSW) and cranberry girdler (CBG) are larvae of "lawn moths." The moths are characterized by wings that are partially folded around the body giving the moths a very slender appearance as well as a pronounced "snout." The LSW is one of the larger webworms with a wingspan of 21 to 35 mm, while the CBG is smaller with a wingspan of 20 to 25 mm. The wings are usually white, grey or tan, and may have patterns of silver, gold, copper or other colored scale. Larvae can cause considerable damage to turf areas if conditions favor their development. However, due to the high natural mortality of small larvae, damage is seldom severe. Presence of larvae is indicated by dying back of grass shoots until irregular brown spots occur. Close examination usually shows leaf blades chewed off at base of plant.

Biology and life history Webworms overwinter as larvae in the soil. Adults emerge in late May through June. Moths have erratic flight, move freely over lawn about dusk, and are attracted to light. Adults lay eggs shortly after emergence. Eggs hatch in 5 to 14 days and the young larvae feed on the tender young grass leaves, spinning a protective silky web. As the larvae mature, they construct subterranean burrows and feed only at night. CBG will burrow into the crown and feed on plant roots, and is often referred to as the subterranean webworm. In the PNW, the larval stage lasts through the winter and may involve as many as 8 instars.

Scouting and thresholds Worms or worm droppings can be detected by breaking apart a section of dying sod. Thresholds for larval numbers have not been established in the PNW.

Management—biological control

Disease, insect predators and especially bird predation exact a very high toll on larvae, and collectively reduce larval populations up to 90%.

- *Bacillus thuringiensis*—Some formulations are OMRI-listed for organic use.
- beneficial nematodes—Read label carefully for application procedures, timing and appropriate soil temperatures for best efficacy.

Management—chemical control: HOME USE

To protect bees, mow lawns before treatment to remove any bloom that might attract them.

Insecticides listed below are to prevent larval injury to lawns. The insecticides will not greatly reduce the number of moths present at the time of application. Moths will migrate into treated lawns from surrounding areas. Do not permit children or pets on the treated turfgrass until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/flowers in lawns: mow and remove clippings prior to applying insecticides.

- azadirachtin (as a mix with pyrethrins)—Some formulations are OMRI-listed for organic use.
- bifenthrin (often as a mix with other active ingredients)
- carbaryl
- deltamethrin
- fenvalerate
- gamma-cyhalothrin
- indoxacarb
- lambda-cyhalothrin
- permethrin
- phenethyl propionate (as a mix with other active ingredients.)—Some formulations are OMRI-listed for organic use.

- plant essential oils (clove, garlic, thyme, etc.)—Some have demonstrated efficacy against Lepidopteran larvae. Some formulations are OMRI-listed for organic use.
- pyrethrins —Some formulations are OMRI-listed for organic use.
- tetraniliprole (Tetrino) at 16-32 oz/A (for larvae). Will provide 8 to 14 weeks of control depending on rate. Maximum yearly rate is 64 oz/A.

Management—chemical control: COMMERCIAL USE

To protect bees, mow lawns before treatment to remove any bloom that might attract them.

Insecticides listed below are to prevent larval injury to turf areas. The insecticides will not greatly reduce the number of moths present at the time of application. Moths will migrate into treated turf stands from surrounding areas. Do not permit children or pets on the treated turfgrass until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/ flowers in lawns: mow and remove clippings prior to applying insecticides.

- acephate (Orthene Turf Tree & Orn. WSP)
- azadiractin (Nemix 4.5 IGR)—OMRI-listed for organic use.
- beta-cyfluthrin (Tempo SC Ultra Insecticide,)
- bifenthrin (Talstar S, Select Insecticide, multiple label names) at 0.05 lb ai/A or 10 fl oz/A. Can be applied up to 0.1 lb/Ai/A per treatment. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply bifenthrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. Do not apply if rain is expected within 24 hr or whatever time is necessary for product to dry
- bifenthrin + imidacloprid (Allectus G Insecticide)—**Note**: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- carbaryl (Sevin Brand RP4 Carbaryl, Lebanon Sevin 7G Granular Insect Control, Sevin SL Carbaryl Insecticide)
- chlorantraniliprole (Acelepryn Insecticide, Acelepryn G Insecticide) at 0.1 to 0.2 lb ai/A.
- clothianidin (Arena 0.25G Insecticide, Arena, 50 WG Insecticide, Arena 50 WDG Insecticide)—Apply as soon as overwintering adults are seen in the spring. **Note**: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- clothianidin + bifenthrin (Aloft GC G Insecticide, Aloft GC SC Insecticide, Aloft LC G Insecticide, Aloft LC SC Insecticide)—Restricted use.
- cyantraniliprole (Exirel WG)
- cyfluthrin (Tempo 20WP Golf Course Insecticide in WSP, Tempo 20 WP Insecticide)
- cypermethrin (Demon WP Insecticide)—Highly toxic to fish.
- deltamethrin (Deltagard G Insecticide, D-Fense SC Insecticide, Suspend SC Insecticide)—For adults.
- dinotefuran (Zylam)—**Note**: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- esfenvalerate + prallethrin + piperonyl butoxide (Onslaught FastCap Spider and Scorpion Insecticide)
- gamma-cyhalothrin (Optimate CS Controlled Release Insecticide)
- indoxacarb (Provaunt)—For larvae.
- lambda-cyhalothrin (Scimitar, Demand CS Insecticide, Demand EZ Insecticide, Demand G Insecticide, Cyonara 9.7 Insecticide, Cyzmic CS Controlled Release Insecticide, Exile 9.7, Patrol Insecticide)
- methomyl (Lannate, Lanox, Nudrin)
- mint oil, geraniol + oil of rosemary (Keyplex Ecotrol Plus Insecticide/Miticide, Essentria IC3 Insecticide Conc.)—OMRI-listed for organic use.
- spinosad A & D (Conserve SC Turf & Ornamental Insect Control) —Some formulations are OMRI-listed for organic use.
- thiamethoxam (Meridian 0.33G Insecticide, Meridian 25WG Insecticide, Flagship 25WG Insecticide)—**Note**: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- trichlorfon (Dylox 6.2 Granular, Dylox 420 SL Turf & Ornamental)—For larvae.

Turfgrass—White grub

Includes *Popillia japonica*, *Aphodius majale* and *Cyclocephala lurida*

Pest description and crop damage White grubs are the larvae of a number of scarab beetle species. Destructive turfgrass pests found in the Pacific Northwest in the scarab beetle family include the invasive Japanese beetle *(Popillia japonica*), European chafer *(Aphodius majale)* and *Southern* masked chafer *(Cyclocephala lurida).* The adult Japanese beetle is 0.5 inch in length with iridescent, copper-colored wing covers and a green thorax and head. The adult European chafer is 0.5 inch in length with light-brown or tan head, thorax, abdomen and wing covers. The insect's eyes are dark-brown to black. The Southern masked chafer is very similar in appearance to the European chafer with the exception of a dark-brown to black head. Adult Japanese beetle and chafer are observed as early as May with a peak in population in early July. Adult Japanese beetle and chafer are much larger than adult billbug, which is 0.375 inch long, black in color, with a distinct snout. May beetle (*Serica* spp.) and 10-lined June beetle *(Polyphylla* spp.) are also found in the Pacific Northwest but are rarely detrimental to turfgrass.

Japanese beetle and chafer spend most of their life cycle (July to the following May) underground as root feeding larvae or grubs. These grubs have robust, cream-color bodies, dark-brown heads and six legs and reach a length of 1 inch in the fall. Mammals (skunks, racoons and birds) will uproot large sections of turf in the fall when feeding on these grubs. Grubs that make it through the fall and winter months will produce damage in the following spring and summer months. Damage at this time appears as patches of turf that are not anchored to the soil and are prone to drought and heat stress despite regular irrigation. Populations of these invasive insects are most prevalent in the Seattle/Tacoma area, with small satellite

populations observed in the Portland area.

Biology and life cycle Adult Japanese beetle and European chafer are found flying in June and July. The mature or late instar larval populations cause the most damage from October to the subsequent May.

Scouting and thresholds Scouting should be initiated in the fall months (August and September), before larvae reach maturity or the third instar. At this time damage will increase and insecticide will be less effective. Mammal predation will begin in the fall and continue in the spring. Insects surviving to the spring will produce visible damage in the late spring and summer months. Symptoms will include heat and drought stress, and a compromised root system. Action thresholds are between 5 to 10 larvae for sq ft in well-maintained turfgrass. Scout in the top 2 inches of the soil using a shovel.

Management—cultural practices

Frequent irrigation will be required to sustain turfgrass growth when infestations of Japanese beetle and chafer are not treated in the fall. The larvae feed on the root systems, comprising the plants' drought stress.

Management—biological control

Beneficial nematodes can be used to reduce Japanese beetle and chafer populations. Read the label carefully for application procedures, timing, and appropriate soil temperatures for best efficacy.

Management— insecticides

For specific product details always consult the label when considering a pesticide application. Some general considerations for best control include spraying during the early instar period (August and September) when grubs are active and near the soil surface. Irrigating the treated area immediately after application with 0.5 to 1 inch water to wash insecticide into underlying soil is often recommended. Consult the labeled reentry period and as a precaution do not permit children or pets on the treated turfgrass until it has been watered to wash the insecticide into the turf and the grass is completely dry. Most insecticides are toxic to bees exposed to direct treatment or to residues on blooming weeds/flowers in lawns.

Products for Commercial Use:

- acephate (Orthene Turf Tree & Orn. WSP)
- azadiractin (Nemix 4.5 IGR)—OMRI-listed for organic use.
- bifenthrin (Talstar, Capture, Brigade), often mixed with other active ingredients
- carbaryl (Sevin Brand RP4 Carbaryl, Lebanon Sevin 7G Granular Insect Control, Sevin SL Carbaryl Insecticide)—For larvae.
- chlorantraniliprole (Acelepryn Insecticide, Acelepryn G Insecticide)—For larvae.
- clothianidin (Arena 0.25G Insecticide, Arena, 50 WG Insecticide, Arena 50 WDG Insecticide)—Apply as soon as overwintering adults are seen in the spring. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- dinotefuran (Zylam)—Provides only suppression of white grub larvae. Must apply prior or during egg hatch for control. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- imidacloprid (Fortify Season Long Grub Control, Adonis 2F Insect Conc., AmTide Imidacloprid, Avatar PLX Insecticide, Lesco Bandit 0.5G Granular Insecticide, Lesco Bandit 2F Insecticide, Lesco Bandit 75 WSP Insecticide, Malice 0.5G, Malice 2F Insecticide, Malice 75WSP, Mallet 0.5G Insecticide, Mallet 2F Insecticide, Mallet 2F T&O Insecticide Mallet 75 WSP Insecticide, Mallet 7.1% PF Insecticide, Merit 0.5G Insecticide, Merit 2F Insecticide, Merit 75WP Insecticide, Merti 75WSP Insecticide, Midash 2SC T&O, Prokoz Zenith 0.5G Insecticide, Prokoz Zenith 2F Insecticide, Quali-Pro Imidacloprid 0.5G, Quali-Pro Imidacloprid2F T&O, Quali-Pro Imidacloprid 75 WSB Insecticide in WSP)—For larvae. Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- spinosad A & D (Conserve SC Turf & Ornamental Insect Control)
- thiamethoxam (Meridian 0.33G Insecticide, Meridian 25WG Insecticide, Flagship 25WG Insecticide)—Note: Neonicotinoid pesticides have been banned from use on public properties in some towns and counties (check with local authorities).
- trichlorfon (Dylox 6.2 Granular, Dylox 420 SL Turf & Ornamental)—For larvae.
- tetraniliprole (Tetrino) – For larvae at 16-32 oz/A, applied when adults are observed to control larvae for 3+ months. Maximum yearly rate is 64 oz/A.

Products for Home Use:

- bifenthrin
- carbaryl
- chlorantraniliprole
- imidacloprid
- permethrin
- spinosad