



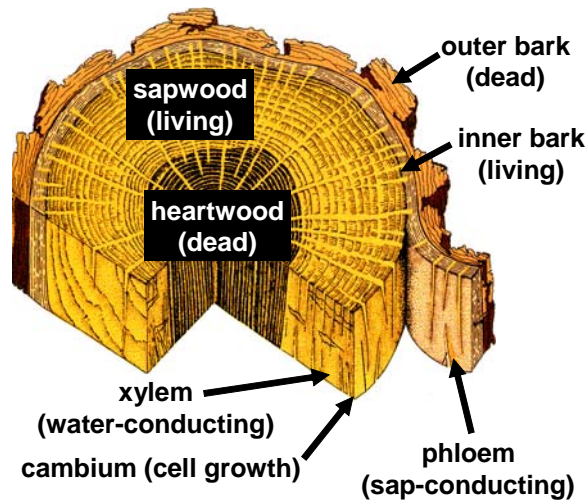
## BARK BEETLES, cont'd

host plants: primarily conifers – Douglas fir, larch, pines, spruce, true fir  
some broadleaves – elms, fruit trees (apple, cherry, pear, plum)

bark beetles are host-specific (no single species attacks all host trees)

western pine beetle	ponderosa pine
mountain pine beetle	ponderosa pine, white pine & others
Douglas-fir beetle	Douglas fir (or western larch, downed trees only)
pine engraver	pine (esp. ponderosa pine)
fir engraver	grand fir, white fir, California red fir

injury: larvae consume phloem tissue (= sap-conducting tissue) & girdle tree



mutualistic relationship between bark beetle adults & tree-infecting fungi  
beetle carries fungus → fungus infects tree → weak tree = optimal larval host

examples: conifer bark beetles vs “blue-stain” diseases  
lesser elm bark beetle vs Dutch elm disease

symptoms: yellowish-to-reddish frass = feces (dry sawdust) at entry holes and around tree base  
pop-corn-shaped masses of dripping resin & streaming pitch tubes at gallery entry  
flaking-away of bark by woodpeckers during winter in search of larvae  
“faded” dried-out trees  
yellowish-green needles ⇒ orange (fall/winter) ⇒ “redtops” burnt brownish-red

biology: coordinated mass-attack  
random initial colonization  
sex pheromones + aggregation pheromones initiate attack  
eggs laid in tunnels (= galleries) made by female beetles that tunnel w/in inner bark

**BARK BEETLES, cont'd**

biology: seasonal generations and O/W stages varies w/species

BARK BEETLE	generations per year	overwintering stage	adult flights to healthy trees
western pine beetle	1-2	larvae	June-Sept
mountain pine beetle	1	larvae & adults	July-Aug
Douglas-fir beetle	1	adults	April-June
pine engraver	2	larvae & <u>adults</u>	April/May June/July
fir engraver	1	larvae	July

tree-killing infestations in conifers usually require:

- (1) stressed trees
  - esp. drought-stress (April-to-June rainfall 75% less than normal)
  - very young or very old trees; overly-crowded trees (else “pitch-out” in healthy tree w/normal resin flow)
  - attack by other insect pests (Douglas-fir tussock moth) or pathogens
  - lightning & fire-damaged trees
  - mechanical damage (home construction, powerline tree pruning & topping)
  
- (2) fresh green dead limbs & trees during January through June
  - storm-damage (snow, ice and wind breakage); logging slash (ready larval hosts ⇒ initial buildup ⇒ massive attack on healthy trees)

**environmental stress + tree breakage ⇒ bark beetle infestations 1-2 years later**

**MANAGEMENT OPTIONS**

physical: ???

- cultural: bark beetles = symptom of tree condition vs pest problem themselves
- maintain tree vigor via ample watering, appropriate tree spacing (thinning), avoid soil compaction, root pathogens or other root injury (esp. transplanted trees during 1<sup>st</sup> two growing seasons)
  - remove & destroy (burn, chip, bury) dead limbs and broken tops where early beetle generations breed (esp. from Jan-June)
  - haul cut logs to “safe” site (1-mile distant from susceptible trees) for beetle emergence (safe to use wood afterwards)
  - cut heavily infested, badly weakened trees

biocontrol: native predators & parasitoids (but no practical manipulations)

least-toxics: ???

## **BARK BEETLES, cont'd**

conventional  
insecticides: NO effective remedial applications after larvae present

preventive trunk sprays

- kill adult beetles as they tunnel into tree BEFORE they lay eggs  
(see pg 11 for general adult flight times)
- spray trunk to saturation (not run-off), ground-level up to limbs 5-inches diameter
- homeowner products
  - carbaryl insecticide (only certain formulations)
  - permethrin insecticide (*Bonide Borer-Miner Killer Concentrate* [2.5% a.i.]])

**ALWAYS READ THE LABEL!**

**Never recommend a product unless both pest and target site (plant) are listed**

## SCALE INSECTS

species: ORDER HOMOPTERA = sap suckers  
= gradual metamorphosis

pests as nymphs ± adults

### armored scales

"shell" ≠ body wall (unattached)  
NO honeydew production  
NEVER mobile after crawler stage  
parenchyma feeders

VS

### soft scales

"shell" = body wall (attached)  
often ABUNDANT honeydew  
some mobile after crawler stage  
phloem feeders

common examples:

**Juniper scale**  
**Oystershell scale**  
**Pine-needle scale**  
**San Jose scale**

**Cottony maple scale**  
**European elm scale**  
**Lecanium scale**  
**Soft brown scale**  
**Spruce bud scale**



identification: varies w/species  
– small, immobile, easily overlooked  
– pinhead-size brown pimples on stems and tree fruit  
– 1/4-inch "turtle shells" on stems and bark  
– tiny oblong cottony white masses on pine needles

host plants: landscape trees and shrubs, berries & fruits

symptoms: similar to aphids  
– honeydew, sooty mold, ants & wasps  
– yellowing, wilting, leaf fall  
– plant death after several years of severe infestation

## SCALE INSECTS, cont'd

biology: varies w/species (generally O/W as eggs under “shell” of dead female)  
1-3 generations outdoors, continuous generations indoors

target 1st stage crawler for control (monitor w/double-sided sticky tape trap)

### CONTROL OPTIONS

physical: cotton swab dipped in rubbing alcohol  
prune & destroy infested foliage

cultural: maintain plant vigor via proper fertility & watering

biocontrol: conserve natural predatory & parasitic insects

least-toxics: early-spring dormant oil spray  
– apply just buds swell when daytime temperatures > 45°F

insecticidal soap OR neem OR summer oils when crawlers present

insecticides: when crawlers present  
– acephate, bifenthrin, carbaryl, cyfluthrin, malathion, permethrin

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## INSECTICIDAL SOAP

trade names:	Safer Insecticidal Soap & many others
active ingredient:	sodium salts of fatty acids
target pests:	soft-bodied, slow-moving, plant-feeding insects aphids, adelgids, mealybugs, scale crawlers & whiteflies small caterpillars spider mites thrips
target plants:	household plants edible fruits and vegetables landscape flowers, trees, shrubs turf
mode-of-action:	dissolves cell membranes    paralysis & death requires direct contact w/wet spray no residual action after spray dries
safety:	oral LD <sub>50</sub> = 16,500 mg/Kg

### **SPECIAL NOTES – *Interpreting LD<sub>50</sub> values***

Lethal Dose (all at once) that kills 50% population experimental test animals  
mg toxin per kg body weight                      (oral or dermal exposure)  
micrograms toxin per liter air                      (via inhalation)

#### useful conversion factor:

(oral LD<sub>50</sub> mg poison ingested per kg body weight) ÷ 625 = oz poison / 100-lbs body weight

example: estimated lethal does for person who weighs 170-lbs

insecticidal soap oral LD<sub>50</sub> = 16,500 mg/kg  
16,500 mg/kg ÷ 625 = 26.4 oz /100-lbs x 1.7 = 44.9 oz  
= 2.8 lbs

notes:	± phytotoxicity hairy vs smooth leaves
	± harm to beneficials flightless, soft-bodied immatures vs highly mobile, hard-shelled adults