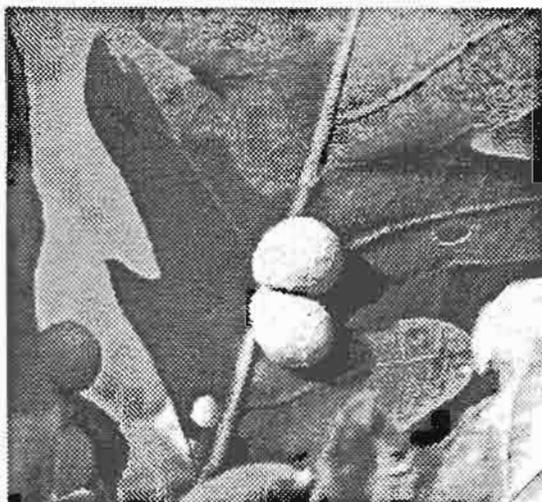


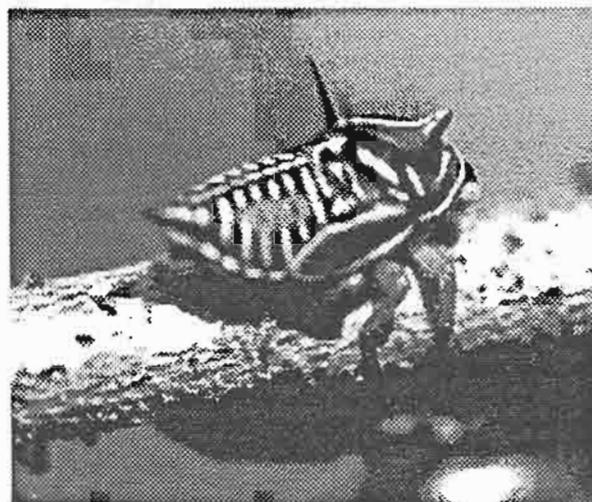


Common Pests of California Oaks

by Bruce W. Hagen¹



Oak galls



Oak treehopper

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COMMON PESTS OF CALIFORNIA OAKS

by Bruce W. Hagen

California's native oaks live with a multitude of plant pathogens and arthropod (insect and mite) pests throughout their lives. As many as 800 insects and more than 200 diseases have been reported on oaks (Swiecki, Bernhardt and Arnold, 1990). All life stages and virtually all parts of oaks are affected. While few of these pests cause serious damage in undisturbed oak rangeland, some become quite destructive in the urban landscape. In general, the impact of insects and disease is more severe on stressed, severely disturbed or aging trees. The resistance of oaks to pests is greatly influenced by their age, rate of growth, condition of their parts, environmental and site conditions and overall health. Environmental conditions also influence the distribution, reproduction and success of oak pests. Consequently, certain pests may be more abundant in some parts of an oak's range, and their impacts vary from year to year.

ENVIRONMENTAL STRESS

Severe or prolonged exposure to adverse environmental conditions, e.g., drought, flooding, extreme heat/cold, mineral imbalances, air pollution, competition, etc., cause plant stress, predisposing oaks to pest problems. Stress, unless mitigated, can lead to dieback and decline by inhibiting normal physiological functions, e.g., growth, respiration, photosynthesis, defense, etc.

URBAN DEVELOPMENT

Changes in an oak's growing environment caused by grade change, pavement, soil compaction, excessive irrigation to maintain incompatible landscaping, etc., affect root function and other life processes. Such activities can cause immediate, severe or prolonged, low level stress. Direct root loss from excavation can also cause drought stress. Depending on severity, trees may die suddenly, decline over a period of years or ultimately recover. Age and health at the time of injury greatly influence the outcome, although, insect and disease pests are the determining factor.

It may be difficult for homeowners to identify construction injuries because they are often concealed by turf, mulch, top soil or ornamental landscaping. Any construction around existing trees will invariably impact tree health. The symptoms of environmental stress, disturbed growing conditions and root injury include: wilting, premature leaf drop, leaf yellowing, sparse and undersized foliage, dead branches, and dense sprouting along the branches and trunk (epicormic growth).

INSECTS

Native insects seldom kill their host, although some, like the California oakworm, can temporarily reduce growth predisposing the tree to other, more potentially serious pests, e.g., oak root fungus, carpenterworm, pit scale, etc. Although pest populations fluctuate widely, oaks and their native insect pests normally co-exist. Pest populations typically increase when environmental conditions favor their development or become stressful to oaks. Fire damage, defoliation, wounding, construction injury, poor cultural practices, inappropriate pesticide use and frequent irrigation also predispose oaks to insect injury by causing stress. Insect pests of oaks can be grouped by the type of damage they cause, e.g., defoliators (leaf feeders), sap feeders, wood/inner-bark borers and gall formers.

Defoliators, predominantly moth larvae, cause the greatest injury. Their outbreaks are typically sporadic and of short duration. Nonetheless, repeated defoliation can affect tree vitality and even survival on some sites.

Sucking insects often occur in abundance on oaks, especially on the new growth. Symptoms include sticky, blackened, curled, yellowed or spotted foliage, dieback, and decline. Among the sap feeding insects, the oak pit scale, a foreign pest introduced without its natural enemies, is the most destructive. Pit scales increase during drought. They can kill stressed trees, especially those in the urban landscape when heavy populations occur year after year.

Boring insects attack trees stressed by drought, disease, defoliation, root loss due to construction, etc. Many bore in the inner bark (phloem) and cambium, girdling tree limbs or trunk. Others bore into the wood, weakening tree structure and introducing pathogens causing decay.

GALL-FORMING PESTS

Over 200 species of gall-forming pests on native oaks have been described. Galls are abnormal, insect or mite induced growths that provide both food and shelter for the pest. They vary greatly in size, shape, color and location, and can be found on leaves, flowers, acorns, buds, twigs, branches and roots. Each gall-forming insect or mite produces a characteristic gall that can be used to identify the pest. Although certain species can kill branches or portions of leaves, they seldom cause significant injury. Heavy

infestations, year after year, however, have a debilitating effect. High populations of gall forming pests appear to be associated with stressed or weakened trees.

DISEASE

Fungal diseases play a major role in the growth, survival and regeneration of oaks throughout California. Wood decay, cankers, canker rots and root disease are important causes of mortality in rangeland oaks (Swiecki, Bernhardt and Arnold, 1990). Largely opportunistic, these pathogens attack stressed trees.

Canker causing fungi kill the bark and cambium of trees frequently girdling and killing branches. Some also decay the sapwood below. Symptoms usually appear as dead, sunken areas in the bark.

Canker rots, on the other hand, are caused by wood decaying fungi that ultimately kill the cambium and phloem, giving rise to cankers which may close with time. This group of fungi is characterized by a white rot of the heartwood frequently leading to limb and trunk failure. By comparison, red-brown rot of the heartwood is quite common in oaks and typically caused by the sulfur fungus.

Root and butt rot (wood decay) are especially important in the decline, failure and death of oaks. Undoubtedly, the two most important root pathogens of landscape oaks are oak root fungus and crown rot. Both can readily kill trees receiving frequent irrigation. Trees disturbed by development and construction are particularly susceptible.

Although foliar diseases are important in the urban landscape, they appear to have little impact on rangeland oaks. Several species of anthracnose fungi affect oaks statewide. These fungi attack leaves and young shoots. Damage ranges from leaf spotting to killing of leaves and shoots. Most foliar diseases are opportunistic and cause infection and injury when environmental conditions are favorable, e.g., cool, wet weather.

LEAFY MISTLETOE

This parasitic plant obtains water and minerals from its host, while producing most of its own carbohydrate (food). Heavily infested branches can be killed when they are unable to meet their own water demand and that of the parasite. Galls remaining after mistletoe plants die are subject to insect pests and pathogens causing decay.

INTEGRATED PEST MANAGEMENT

Pests typically play a secondary role in the dieback and decline of trees. Environmental stress, site distur-

bance, increasing age and mechanical injury are the primary inciting factors which reduce vigor predisposing trees to insect and pathogens. While it is important to mitigate certain pest problems, pest management alone, will not improve tree health, alleviate stress or improve growing conditions. A more comprehensive (integrated) pest management approach is needed. By definition, integrated pest management (IPM) implies the use of all control options: biological (natural enemies); cultural (improved tree care) physical (hand picking, hosing off, pruning out, etc.) and chemical (pesticides, oils, soaps, biological pesticides). The key to IPM is to monitor regularly and to act when pests threaten to cause unacceptable damage. The most effective, long term and least toxic methods are emphasized.

Normal tree growth and health are best ensured by creating/restoring and maintaining favorable growing conditions throughout the life of the tree. A comprehensive tree health program should include:

Pruning: minimal thinning, shaping, structural improvement, and removal of dead, diseased and hazardous branches.

Irrigation: judicious watering to avoid drought stress. Water deeply in the spring when winter rainfall is below normal. It may also be advantageous to water once or twice later in the year, especially on poor sites or when the weather is particularly hot and dry. Be sure to keep water well away from the trunk. Tree's whose roots have been cut during construction are under particular drought stress.

Mulching: add two to four inches of organic mulch to the soil surface below the tree's canopy.

Fertilization: mineral deficiencies typically occur around trees where the leaves are regularly removed, disrupting mineral recycling. Trees that have dense, green foliage and appear to be growing reasonably well usually need little supplemental fertilization. Fertilize sparingly unless you have had the soil analyzed.

Maintenance of favorable growing conditions: avoid soil compaction, over-fertilization, excess moisture, turf and extensive landscaping under the canopy.

Protection from injuries: non-technical pruning, excavation within the drip line (periphery of foliage), grade change, girdling wires, bark injuries, root pruning, trunk injections, etc.

Reduction of hazard potential: have a Certified Arborist (Western Chapter of the International

Society of America) evaluate tree for potential structural failure. Structural pruning, cabling, bolting, propping and/or removal may be warranted.

Consult an arborist to help develop and implement a tree health program. The following pesticide recommendations are current. However, changing Federal and State regulations may prevent the use of certain pesticides in the future. Consult your County Agricultural Commissioner to verify that the recommended pesticide use is permitted and/or to obtain more detailed information.

SUMMARY

While most insect and disease pests of oaks cause minor injury, their effects may be cumulative. Insects and diseases frequently exert their impacts as an interacting complex influenced largely by environmental conditions and tree vigor. Dieback, decline and sometimes death may result. Pest problems, increasing age, environmental stress, construction injury and harmful cultural practices are all important factors affecting the health, growth, longevity and survival of oaks. Healthy, stress-free trees are less susceptible to most pests and are more tolerant of the injury caused by others.

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COMMON INSECT PEST	DESCRIPTION	SYMPTOMS/SIGNS/INJURY	MANAGEMENT	ADDITIONAL
LEAF FEEDERS				
California Oak Moth <i>Phryganidia californica</i>	Larvae black with longitudinal yellow to olive stripes, 1 ¼" long when mature.	Defoliation/loss of vigor, droppings, frass (fecal pellets, wood chips) and caterpillars are a nuisance.	<i>Bacillus thuringiensis</i> (B.T.), Carbaryl, Acephate.	2-3 gen/yr. Summer generation most damaging. Overwinters as larvae. Most common in coastal valleys.
Tent Caterpillars <i>Malacosoma californicum</i> <i>Malacosoma constrictum</i>	Hairy, brown larvae with blue spots and orange to white tufts, up to 2".	Defoliation. Small, silk tents.	Carbaryl, Acephate, Dursban, B.T., Dormant oil (egg masses), Insecticidal soap. Remove tents.	1 gen/yr. Overwinters in egg masses on twigs. Mostly N. Calif.
Western Tussock Moth <i>Orgyia vestusa</i>	Larvae to 1", red and yellow spots, white to brown tufts, black bristles at both ends.	Defoliation, tan cocoons on trunk.	See pesticides above. Hand removal of cocoons and egg masses.	1 gen/yr. Eggs in clumps on old cocoon.
Fruittree Leafroller <i>Archips argyrospilus</i>	Larvae to 1", green with black heads.	Defoliation, leaves folded and tied with silk.	Carbaryl, Diazinon, Dormant oil (egg masses).	1 gen/yr. Overwinters in egg masses on limbs.
Oak Ribbed Casemaker <i>Bucculatrix sibertiella</i>	Larvae to ¼". Cocoons white, cigar shaped and ribbed.	Leaves skeletonized.	Apply Carbaryl when serious damage occurs.	2 gen/yr, (Spring, Summer).
Oak leaf sawfly <i>Periclista</i> sp.	Larvae light green, slightly transparent. Head capsule is light brown to black. Distinctive "Y" shaped barbed spines in rows along their backs. Larvae are ⅓ to ½ inch.	Defoliation of buds and expanding leaves. Damage may be serious.	Treatment generally unnecessary. Apply Carbaryl or Acephate when damage is serious.	1 gen/yr. larvae pupate in soil. Reported on live oak and valley oak.

COMMON INSECT PEST	DESCRIPTION	SYMPTOMS/SIGNS/INJURY	MANAGEMENT	ADDITIONAL
Live Oak Weevil <i>Deporaus glastinus</i>	Adults dark, blue-green snout beetles to 1/4".	Leaves gouged and etched.	Carbaryl	Most common on Coast live oak. Damage occurs April to June.
WOOD/INNER BARK FEEDERS				
Carpenterworm <i>Prionoxystus robiniae</i>	Larvae off-white to 2 1/2".	Tunnels in inner-bark, wood of branches, trunk. Frass expelled through 1/2" holes in bark.	Reduce stress. Inject ethylene dichloride into holes and plug. Parasitic nematodes are effective.	3-4 yr cycle. Causes decline and decay and weakens tree structure.
Oak bark beetles <i>Pseudopityophthorus spp</i>	Adults brown to 1/8". Larvae white, legless grubs found under bark.	Branches and trees killed. Bleeding, frothy liquid bubbling from tiny holes. Fine boring dust collects on bark.	Maintain tree health to prevent attack. Presence indicates stress.	2+ gen/yr. Galleries at right angles to wood grain. Cambium girdled by boring.
Oak cordwood borer <i>Xylotrechus nauticus</i>	Larvae off-white, slightly flattened to 3/4". Fairly stout.	Inner bark and wood riddled with mines filled with frass.	Reduce stress.	1 gen/yr. Often associated with <i>Neoclytus conjunctus</i> . Mostly in dying oaks and cut firewood.
Oak twig girdler <i>Agrius angelicus</i>	Larvae off-white, legless and sausage-like, to 1" found under bark of small twigs up to 1/2".	Patches of dead foliage, spiraling galleries between bark and wood	Maintain tree health to prevent attack. Use Carbaryl as protectant when adults emerge (May-June).	2 yr. life cycle. Most serious in S. Calif. on live oaks. Drought stressed trees susceptible.
Pacific flatheaded borer <i>Chrysobothris mali</i>	Larvae off-white with flattened, amber colored heads, to 3/4". Found under bark of dead and dying branches.	Branch dieback. Moist areas on bark. Shallow, oval tunnels in innerbark and wood packed with powdery frass.	Major pest of newly planted trees. Reduce stress. Protective sprays.	1 gen/yr. Adults June/July May be found in firewood. Only stressed tree attacked.

COMMON INSECT PEST:	DESCRIPTION	SYMPTOMS/SIGNS/INJURY	MANAGEMENT	ADDITIONAL
Western Sycamore Borer <i>Synanthedon respiciens</i>	Larvae pink to ¾" long.	Larvae burrow in inner-bark and cambium. Bark on major branches roughened. Growth retarded.	Apply Carbaryl to large branch crotches.	Empty pupal cases protruding through damaged bark indicate emergence. Most serious in S. Calif.
SAP FEEDERS				
Ehrhorn's oak scale <i>Mycetococcus ehrhorni</i>	Small (1mm) red scale insects covered by a mat of white fungal growth. Fungus feeds on honeydew.	Undersides of limbs appear white or white spotted.	Fungus: • Bordeaux mix or Copper cmpds. • Benomyl Scale: • Horticultural oil • Oil plus: • Malathion, Diazinon, • Carbaryl	Most common in S. Calif. on coast live and valley oaks Reported as far north as Humboldt County.
Oak treehopper <i>Platycotis vittata</i>	Adults to ¾", off-white with red-orange stripes. Distinct thorn-like projection from head.	Suck sap, insertion of eggs into slits cut in bark causes some dieback of twigs.	Control seldom warranted.	2 gen/yr. Nymphs are black with yellow and red markings. They feed gregariously.
Oak lecanium scale <i>Parthenolecanium quercifex</i>	Mature scales dark brown, hemispherical and up to ¼".	Suck sap from twig. Dripping honeydew leads to blackened (sooty mold covered) foliage.	Apply oil, insecticidal soap, oil plus Malathion to crawlers.	1 gen/yr. Most serious in S. Calif. Treat late April to early May.
Oak pit scale <i>Asterolecanium spp.</i>	scales pinhead size, greenish to brown. Raised swelling surround each scale.	Suck sap, leaf flush delayed, dieback and decline, dead leaves persist. Twigs and small branches appear pitted.	Dormant oil, oil plus Carbaryl or Malathion Several applications may be necessary. Crawler production peaks in early summer.	1 gen/yr. Most common on deciduous oaks. Causes some mortality.

COMMON INSECT PEST:	DESCRIPTION	SYMPTOMS/SIGNS/INJURY	MANAGEMENT	ADDITIONAL
Whiteflies Crown whitefly <i>Aleuroplatus coronata</i> Stanford whitefly <i>Tetraleurodes stanfordii</i>	Immatures are about 1/16", black, oval, flattened with a white waxy fringe.	Suck sap on underside of leaves. Dripping honeydew blackens foliage. May be a nuisance.	Apply Malathion to adults in spring if pest becomes a nuisance. Oil (Immatures) Insecticidal soap.	Common on live oak. Flying adults often a nuisance. Injury is usually minimal.
Woolly Oak Aphid <i>Stegophylla quericola</i>	Greenish to bluish insects to 1/8", covered with white waxy material.	Suck sap on undersides of leaves.	Control usually unwarranted. Insecticidal soap, horticultural oil.	Found on coast live oak
Oak phylloxera <i>Phylloxera stellata</i>	Tiny yellow, aphid-like insect on undersides of leaves.	Yellow, spotted leaves. Spots coalesce into brown blotches.	Control not investigated.	Found on valley, white and coast live oak. A pest of stressed trees.
GALL FORMERS				
Galls Over 200 species of cynipid gall wasps A few moths, beetles and flies can cause.	Abnormal, swellings on leaves, stems, flowers, buds, and roots. Immatures are found inside.	Unightly, may kill portions of leaves and small branches. Heavy infestations impact health.	Reduce stress. Control difficult and usually unjustified. Carbaryl applied at budbreak may be helpful.	Each gall maker forms a gall of particular size, shape and color.
Live Oak Gall <i>Dryocosmus dubiosus</i>	Minute, grub-like insects in small, nearly round galls on leaf veins on underside of leaves.	Leaves appear scorched at tips and margins.	Control not justified.	Larvae overwinter in soil.
Erineum mite <i>Aceria mackiei</i>	Raised blisters on leaves, brown felt-like material in depression on underside of leaves.	Suck sap, but cause little damage.	Common, but not significant.	Found on coast live oak.

COMMON INSECT PEST:	DESCRIPTION	SYMPTOMS/SIGNS/INJURY	MANAGEMENT	ADDITIONAL
Brown blister unidentified agromyzid gall fly	Brown, circular spots, up to 5/16".	Importance unknown, not serious.	Not investigated.	Found on black oak.

ACORN PESTS

Weevil <i>Curculio occidentis</i> Filbertworm <i>Melissopus latiferreanus</i>	Immature forms: a beetle grub and a caterpillar, both found inside acorn.	Serious damage to acorn crop. Reduced germination and seedling survival.	Management probably not warranted.	1 gen/yr. May lead to dripping acorn disease caused by <i>Erwinia quercina</i> .
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COMMON DISEASE PESTS	SYMPTOMS/SIGNS	IMPACT	MANAGEMENT OPTIONS
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CANKERS

Branch decline <i>Diplodia quercina</i>	Wilting and browning of leaves on branches up to 4" diameter. Bark, cambium and sapwood killed, wood below is stained brown.	Branch dieback and some mortality. Associated with drought stress.	Maintain tree health Prune out affected branches Nov-Jan. Apply Thiofanatemethyl to pruning cuts.
Perennial canker Perhaps caused by canker rot organisms (see below)	Cankers-oval to elliptical with concentric callous ridges on trunk and branches. Often near wounds or branch stubs.	Decline and branch failure	Prune dead branches. Reduce environmental stress. Minimize wounding and remove dead branch stubs. Small cankers can be excised.

WOOD DECAY

Canker-rots <i>Inonotus andersonii</i> <i>Inonotus dryophilus</i>	Elongate cankers on trunk and branches with strong callusing. Conks not persistent or conspicuous. Pathogen enters wounds, fire scars and dead branches.	Causes a white rot of heart and sapwood leading to tree failure	Avoid wounding, remove dead branch stubs. Reduce environmental stress.
Sulfur fungus <i>Laetiporus sulphureus</i>	Causes brown cubical rot. Produces soft, fleshy conks yellow to orange above and yellow below. Conks appear summer to fall after years of infection.	Decay and branch failure. Occasionally the roots and lower trunk (butt) are decayed.	Avoid wounding, remove dead branch stubs. Prune properly, e.g. don't make flush-cuts or leave stubs.

COMMON DISEASE PESTS	SYMPTOMS/SIGNS	IMPACT	MANAGEMENT OPTIONS
FOLIAGE DISEASES			
Leaf blister <i>Taphrinia coarulescens</i>	Raised, wrinkled, light green to off-white blisters on affected leaves, noticeable in late summer to early fall.	Leaf spotting unsightly. Heavy infection may cause defoliation or poor growth.	Control as warranted. Becomes a problem in years with cool, wet weather in spring. Tri-basic copper may be helpful.
Powdery mildew <i>Sphaerotheca lanestris</i>	May cause witches' brooms (short shoots with tiny, stunted leaves covered with powdery mildew). They later die and turn brown. Often causes brown powdery patches on undersides of mature leaves.	Unsightly. Common on interior and live oak.	Avoid excessive summer irrigation or mid-summer fertilization. Prune out infected brooms. Apply water with a surfactant, or water with sulfur.
Oak anthracnose <i>Discula quercina</i> (see twig blight below)	Causes irregular brown, dead areas or small spots on leaves. Succulent foliage most susceptible during periods of high humidity.	Unsightly. Most common on black oak.	Copper fungicide. Control usually not warranted.
Twig blight <i>Cryptocline cinerescens</i> <i>Discula quercina</i> (see oak anthracnose above)	Dieback of leaves and shoots of current growth. Symptoms often scattered throughout crown. Infection occurs during leaf expansion. Symptoms appear midsummer to fall. Often associated with pit scale.	Loss of vigor, Some mortality. Unsightly	Prune infected twigs and apply Thiophanatemethyl in fall and spring. Most severe in wet years.
ROOT DISEASES			
Artist conk <i>Ganoderma applanatum</i> <i>G. lucidum</i> , <i>G. browni</i>	Causes white rot. Conks- woody and perennial, found near ground level, brown to gray above and light below with a white margin. Semicircular in shape from above.	Decays sapwood and heartwood of lower trunk (butt) and roots. Leads to windfall.	Avoid wounding the trunk and large roots

COMMON DISEASE PESTS	SYMPTOMS/SIGNS	IMPACT	MANAGEMENT OPTIONS
Oak root fungus <i>Armillaria spp.</i>	Gradual twig and branch dieback. Occasional sudden death. Yellow foliage, premature leaf-drop. White fan-shaped fungal material between bark and wood. Bark unhealthy looking. Wood wet, stringy and decayed. Black root-like structures under bark, on roots and in soil.	Loss of vigor, decline, death. Attacks disturbed and stressed trees, especially those in landscape plantings receiving frequent irrigation.	Remove soil around root crown and leave exposed to air. DISCONTINUE regular irrigation. Reduce stress.
Crown rot <i>Phytophthora spp.</i>	General decline, reduced growth, twig dieback, wilting, yellowing, sparse and stunted foliage, premature leaf drop. Lesions on the bark of large roots and lower trunk often with oozing of dark fluid.	Loss of vigor, decline and death. Serious pest in urban areas.	Remove soil around root crown and allow to dry, keep exposed. Discontinue regular, frequent irrigation, but provide periodic water every 4-6 weeks until tree improves. Gradually cut back to 2-3 times a year.
MISTLETOE			
Leafy mistletoe <i>Phoradendron villosum</i>	Green, leafy parasitic plant invades branches and trunk, obtains water from tree. Spread by birds.	Unightly, heavy infestations can cause water-stress leading to dieback. Dead mistletoe galls are subject to decay.	Remove mistletoe plant and treat the remaining mistletoe stem with asphaltic pruning paint or wrap in black plastic for one year. Apply Ethephon during dormant season. This causes abscission of plant. Can be applied directly to mistletoe stub to reduce regrowth.