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Dwarf Mistletoes

From pages 88-89

White fir dwarf mistletoe
Arceuthobium abietinum Engelm. ex Munz. *f.sp. concoloris* Hawksw. & Wiens
Red fir dwarf mistletoe
A. *abietinum* Engel. ex Munz. *f.sp.magnificae* Hawksw. & Wiens
Lodgepole pine dwarf mistletoe
A. americanum Nutt. ex Engelm.
Western dwarf mistletoe
A. campylopodum Engelm.
Limber pine dwarf mistletoe
A. cyanocarpum (A.Nelson ex Rydberg) Coulter & Nelson
Piñon dwarf mistletoe
A. divaricatum Engelm.
Douglas-fir dwarf mistletoe
A. douglasii Engelm.
Larch dwarf mistletoe
A. laricis (Piper) St. John
Southwestern dwarf mistletoe
A. vaginatum subsp. *cryptopodum* (Engelm.) Hawksw. & Wiens

Hosts-- Eight species of dwarf mistletoe infect all native conifers in the region. Major hosts in this area are Douglas-fir, western larch, lodgepole pine, piñon pines, ponderosa pine, Jeffrey pine and white fir. See Table 4.

Distribution-- Individual ranges vary greatly by dwarf mistletoe species and the range of their respective hosts. See Table 5.

Damage-- Witches brooms often form on infected branches (fig. 140). Top kill is common (fig. 141). Stem cankers or swellings sometimes result from stem infections by dwarf mistletoe. Height and diameter growth reductions can be large. Tree form often is affected as well. Bark beetles sometimes attack trees weakened by dwarf mistletoe infections.


a.

b.

Figure 140. Witches brooms often indicate dwarf mistletoe infection. Brooms result from a proliferation of small twigs on a branch. Douglas-fir (a) and western larch (b) are two species which generally form large, distinct brooms in response to dwarf mistletoe infections. Infections tend to be most severe in the lower portions of the crowns.

Identification-- Witches brooms, cankers, and swellings on stems and branches (fig. 141, 142) are indicators of dwarf mistletoe infections. Dwarf mistletoe plants form shoots on branches or stems of host trees. The shoots may be simple or branched and from 1 to 4 inches in length (fig. 142). They sprout in groups of varying numbers on branches or stems (figs. 143a-d) or occur as scattered shoots on infected twigs (figs. 143e, f). The jointed shoots have opposite pairs of scalelike leaves. Color varies from yellow to purple to brown or olive green. When shoots are shed, small basal cups often remain embedded in the bark (fig. 143b). See Table 3 for help in identifying species of dwarf mistletoe.

Similar damages-- Witches brooms, cankers, and swellings can be caused by a number of other agents. Stimulation brooms often are produced after stands have been thinned. Occasional witches brooms and swellings are caused by frost damage to growing cells in both cambium and buds. *Elytroderma* needle cast causes witches brooms on ponderosa pines. Cankers are caused by a number of common canker-causing fungi. Sunscald and mechanical injuries also cause damages which can be confused with cankers. Presence of dwarf mistletoe plants in damaged stands is the best assurance of dwarf mistletoe infection.

References-- 2, 4, 24, 26, 29, 31, 41, 47, 60, 72

Management Guide for Dwarf Mistletoes

Figure 141. This Douglas-fir stand is heavily infected with Douglas-fir dwarf mistletoe. Witches brooms and dead tops are typical symptoms.

a.

b.

Figure 142. Dwarf mistletoe infections cause spindle-shaped swellings on branches and small stems. Dwarf mistletoe shoots begin to sprout in the spring (a), eventually forming clusters of shoots as seen in this larch dwarf mistletoe plant (b).

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Table 4. Comparison of Dwarf Mistletoes.

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Species	Principal Host	Secondary Host	Rare Hosts	Shoot Length (inches)	Shoot Color	Branching
*Arceuthobium abietinum f.*sp. *magnificae*	RF	--	--	3 - 9	Yellow or Yellow-green	F
f. sp. *concoloris*	WF	SAF	--			
A. americanum	LPP	--	PP, WBP, LP, ES	2.5 - 12	Yellow green	V
A. camylopodum	PP, JP	--	LPP	3 - 5	Brown or green	F
A. cyanocarpum	LP, BP	WBP	WWP	1 - 2	Green	F
A. divaricatum	PNP	--	--	3.5 - 5.5	Olive green to brown	F
A. douglasii	DF	--	GF, SAF, ES	1 - 3	Green	F
A. laricis	WL	SAF, LPP	ES, WBP, PP	1.5 - 2.5	Dark purple	F
A. vaginatum subsp. *crytopodum*	PP var. *scopulorum*	--	LPP, BP	6 - 8	Orange to dull orange	F

Definition of Abbreviations

BP=Bristlecone pines, DF=Douglas fir, ES=Engelmann spruce, GF=Grand fir, JP=Jeffrey pine, LP=limber pine, LPP=Lodgepole pine, PNP=Piñon pines, PP=Ponderosa pine, RF=Red fir, SAF=Subalpine fir, WBP=Whitebark pine, WF=White fir, WL=Western larch, WWP=Western white pine, F=Flabellate (fan-shaped), V=Verticallate (whorled)

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Table 5. Distribution of Dwarf Mistletoes.

From page 91

Species	California	Idaho	Montana	Nevada	Utah	Wyoming
*Arceuthobium abietinum f.*sp. *magnificae*	Northern, Sierra Nevada	--	--	Sheep, Spring and Groom Mountains	North-western Kane County	--
f. sp. *concoloris*	Northern, Sierra Nevada	--	--	--	--	--
A. americanum	Sierra Nevada	Throughout	Western and central	Lake Tahoe area	Northern	Throughout
A. camylopodum	Northern, Sierra Nevada and San Bernardino Mtns.	Northwest, near Coeur d'Alene, Salmon River, Boise	--	Tahoe area, Spring Mtns. on *Pinus ponderosa* var. *scopulorum*	--	--
A. cyanocarpum	Eastern Siera Nevada	Rare. Known in 4 sites in southern Idaho	Southwest, south central	Throughout mountains	Throughout	Throughout
A. divaricatum	Southern	--	--	Central and southern	Central and southern	--
A. douglasii	Northern	Throughout	West of Continental Divide	Wheeler Peak	Throughout	Western extreme
A. laricis	--	Northern and west central	Northwest	--	--	--
A. vaginatum subsp. *crytopodum*	--	--	--	--	Southern Utah	--

a.

b.

c.

d.

e.

f.

Figure 143. Dwarf mistletoe plants: a and b- *Arceuthobium americanum*; c- *Arceuthobium vaginatum*; d- *Arceuthobium. abietinum f.* sp. *concoloris*; e- *Arceuthobium douglasii* female, *f- Arceuthobium douglasii* male.

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Juniper Mistletoe From page 93

Phoradendron juniperinum

Hosts-- Several juniper species; especially Utah, Rocky Mtn. and western juniper.

Distribution-- Throughout Utah, Nevada and California. The pathogen ranges from central Oregon into Mexico.

Damage-- *Phoradendron juniperinum* is a parasitic, flowering plant which is rooted in the branches and stems of live junipers. It survives only on live hosts. Although *P. juniperinum* is a photosynthetic plant, it depends on it's host for water and minerals. The damage done by this parasite can be significant to heavily-infected individuals, but generally is of little consequence in stands of juniper.

Identification-- Round clusters of the olive green mistletoe plants are seen on branches throughout the juniper crown (fig. 144). These mistletoe clusters are commonly 6 to 15 inches in diameter. The leaves of this true mistletoe plant are barely discernible. They are tiny (1 mm), scalelike leaves produced in opposite pairs along the smooth stem of the plant. Branching of the plant is opposite. The male and female flowers are produced on separate plants (dioecious). Female plants produce small pinkish berries. Seeds pass intact through the digestive tract of birds which have eaten *P. juniperinum* berries. Seeds thus deposited on juniper branches adhere and take root; an important means of spread for this species.

Similar damages-- Juniper broom rust (*Gynosporangium nidus-avis*) causes dense witches brooms which look similar to mistletoe from a distance. Also, the naturally "bunchy" habit of juniper foliage may make light mistletoe infections difficult to spot. In both cases, look for mistletoe shoots identify mistletoe infections.

References-- 3, 30

a.

b.

Figure 144. *Phoradendron juniperinum* plants closeup (a) with ripe berries and (b) as they appear in the crown of a juniper.

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Broom Rusts From page 94

Spruce broom rust: *Chrysomyxa arctostaphyli* Diet.
Fir broom rust: *Melampsorella caryophyllacearum* Schroct.

Hosts-- *Chrysomyxa arctostaphyli*: Conifer host= Engelmann spruce; alternate host= Kinnikinnick (*Arctostaphylos uva-ursi*).

Melampsorella caryophyllacearum: Conifer host= grand, white, red and subalpine firs; alternate hosts= chickweeds (*Stellaria spp.* and *Cerastium spp*.)

Distribution-- Occasional throughout range of hosts.

Damage-- Witches brooms are formed on infected branches (fig. 145). Growth loss may occur under conditions of severe infection. Form is sometimes affected by large brooms.

Identification-- Dense witches brooms with stunted, yellow needles readily identify these diseases (fig. 146a). The needles are shed in fall, giving the broom the appearance of being dead during the winter. New, chlorotic foliage develops in spring and the fungus sporulates in early summer. Pustules or tongues (aecia) of yellow or orange spores erupt through the leaf surface (fig. 146b).

Similar damages-- Other species of leaf rust fungi are occasionally encountered on spruce and true firs. While the fruiting appears similar, these fungi do not cause witches brooms.

Figure 145. Spruce broom rust.

References-- 2, 5, 33, 55, 81

Management Guide for Broom Rusts:

Fir Broom Rust
Spruce Broom Rust

a.

b.

Figure 146. Fir broom rust stimulates yellow-tinged witches brooms in fir branches (a). Spores are produced on needles within the broom in early summer (b).

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Elytroderma Needle Cast

From page 95

Elytroderma deformans (Weir) Darker

Hosts-- Ponderosa and Jeffrey pines are the most common hosts. Lodgepole pine and piñon pines are occasionally infected.

Distribution-- Range of hosts

Damage-- Witches brooms form in branches, and small trees are often deformed by loose brooming of the leader. Needles are infected yearly within the broom and are cast after 1 year. Growth loss, deformation, and occasionally death of small trees result. Chronic infections in a few locations have resulted in poor stand productivity due to growth loss and deformity in trees of all ages.

Identification-- New infections are started by spores in late summer. Needles are infected and the fungus grows into the twig and branch cambium. Branch infections are detected by cutting away the bark to expose the cambium. Small pockets of dark resin are distributed throughout the phloem adjacent to the cambium (fig. 147). The witches broom, which forms after a few years' infection, combined with discoloration and shedding of needles within the broom, are good indications of this disease (fig. 148). Infection within the broom is chronic; the new needles are reinfected every year and are shed the following summer. Fruiting bodies (ascomata) are black lines parallel to the needle axis at the lower end of needles (fig. 149). The fruiting bodies split the epidermis in mid to late summer to release spores.

Similar damages-- Ponderosa pine dwarf mistletoe causes witches brooms which retain the normal complement of needles. The needles are green in dwarf mistletoe-infected brooms. Dwarf mistletoe plants are generally present as well. Other needle casts of ponderosa pine will cause discoloration but not brooming.

References-- 2, 33, 21

Management Guide for Elytroderma Needle Cast

Figure 147. Cambium of infected branches has small pockets of dark resin.

Figure 148. Witches brooms form in systemically infected branches.

Figure 149. Fruiting bodies of *Elytroderma deformans* are black lines near the base of needles.

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Pine Shoot Blight From page 96

Sphaeropsis sapinea (Fr.) Dyko & Sutton
[*Diplodia pinea* (Desm.) Kickx]

Hosts-- Ponderosa pine.

Distribution-- Widely distributed. Locally severe in several areas, including west central Montana and in north central Idaho.

Damage-- New shoots are killed by the canker-causing fungus. Severe infections may lead to death of trees of all sizes. Damage in terminals is rare but branches, may be severely damaged by numerous infections. May predispose trees to attack by pine engraver beetles.

Identification-- Stunted new shoots or flagged branches with drooping tan, brown or gray needles occur anywhere in crown (fig. 150). Needles are infected as they emerge from the sheath. Infected needles are stunted and may have a resinous droplet associated with the infection point. The fungus commonly girdles the entire new shoot by the end of summer. Infections may continue to develop into year-old tissues as well. Dead needles remain attached to the twig for several years. Cambium of infected shoots is resinous and discolored. Minute, round, black fruiting bodies (pycnidia) are produced in the spring on twigs, bases of needles, and on cone scales (fig. 151). Spores are released from spring through fall, whenever there is rainfall.

Similar damages-- Branch flagging caused by western gall rust appears very similar from a distance. Look for branch galls to identify gall rust. Western pine shoot borer and gouty pitch midge damages in branch tips are similar but usually only on saplings.

References-- 2, 20, 56


a.


b.

Figure 150. Severely infected tree (a), close-up of infected twig (b).

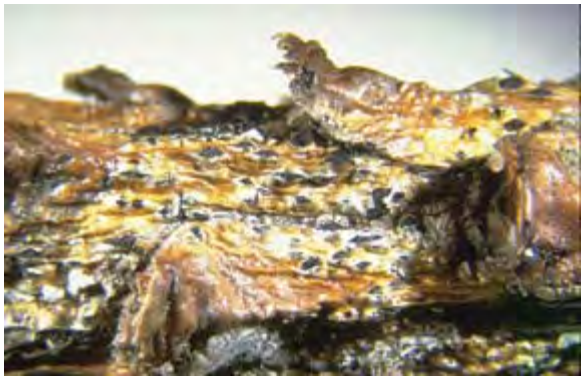

Figure 151. Pycnidia on twig.

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Gouty Pitch Midge From page 97

Cecidomyia piniinopis O.S.

Hosts-- Ponderosa pine; occasionally lodgepole pine.

Distribution-- Throughout host range.

Damage-- Attacks occur near branch tips in early summer. New shoots fade, droop, turn yellow, and die. Repeated attacks which do not kill the shoots may twist and stunt branches. Beneath the bark, small resinous pockets are formed by developing larvae. Trees 4-16 feet in height are most heavily infested. Small trees may be killed.

Identification-- Needles on infested shoots die in tufts which soon droop and turn yellow. Later they become red-brown (fig. 152). These flags are scattered over part or all of the crown and appear by summer. Extensive twig killing, stunted or distorted growth, and sparse, off-colored foliage are symptoms of persistent heavy infestations.

Infested shoots will have slight swellings on their surface which enclose bright orange to red maggots about one-eighth of an inch long (fig. 153) from July to the following June. The resin infiltrates the wood around pits and sometimes exudes over the twig.

Larvae overwinter in pits under bark. Adults emerge in early spring after larvae migrate to surface of branch to pupate.

Similar damages-- Damage is similar to pine shoot blight. Pitchy "gouts" on twigs and larvae, when present, distinguish this pest.

References-- 2, 15, 22

Figure 152. Gouty pitch midge infests and kills shoots, usually of young pines.

Figure 153. Gouty pitch midge maggots within branch swellings.

Management Guide for Gouty Pitch Midge

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Terminal Weevils

From pages 98-99

White pine weevil: *Pissodes strobi* (Peck)
Lodgepole terminal weevil: *Pissodes terminalis* Hopping

Hosts-- *Pissodes strobi*; Engelmann spruce and lodgepole pine. *P. terminalis*; lodgepole pine

Distribution-- *Pissodes strobi*; throughout range of hosts. *P. terminalis*; range of hosts in Idaho and Montana.

Damage-- They attack and kill or badly injure terminals on spruce and lodgepole pine reproduction from 1 to 30 feet in height. Leader mortality results in deformity of the main stem or the production of multiple leaders. Lodgepole terminal weevil kills down to the first whorl but the white pine weevil will kill 2 years' growth (fig. 154).

Identification-- Over wintering is accomplished as adults or larvae. Adults complete development or become active and lay eggs in the latter part of June. Adults of both species are typical weevils with long, curved beaks (fig. 155). They are about one fourth of an inch long and have rough wing covers adorned with red-brown and patches of lighter brown or gray scales. Feeding punctures and egg niches are made in the bark of terminal shoots. Newly hatched larvae initially feed in the terminal just under the bark.

Leaders and terminals will begin to droop following girdling (figs. 154, 157), then die and turn gray or brown (fig. 156). Later, they bore into pith where they remain throughout the larval period (fig. 159).

Look for oval pupal cells or "chip cocoons" of P. strobi under bark of spruce terminals in August (fig. 158).

Similar damages-- Damage is similar to that of *Eucosma* shoot borers or other terminal feeders. Canker diseases can also cause terminal death. Look for distinctive feeding in cambial region of shoots, chip cocoons, or pith mining.

References-- 2, 22

Management Guide for Lodgepole Terminal Weevil

Figure 154. White pine weevil damage in Englemann spruce.

Figure 155. White pine weevil adults near exit holes in an Englemann spruce terminal.

Figure 156. Spruce terminal killed by the white pine weevil.

Figure 157. Lodgepole pine terminal weevil damage in lodgepole pine.

Figure 158. Characteristic chip cocoons beneath bark of spruce terminals distinguish those killed by terminal weevils.

Figure 159. Terminal weevil larva in mined terminal of lodgepole pine.

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Western Pine Shoot Borer From page 100

Eucosma sonomana Kearfott

Hosts-- Ponderosa, lodgepole and Jeffrey pines.

Distribution-- Throughout the range of ponderosa and lodgepole pines and in California and Nevada on Jeffrey pine.

Damage-- Larval mining in the terminal shoots impairs or stops shoot and needle elongation and can affect development of new buds. Repeated attacks reduce tree height and may cause deformed crowns.

Identification-- This moth does not leave feeding scars, webbing, or frass on the surface of infested shoots. About May, larvae enter leaders near terminal buds and mine downward in the pith. Circular exit holes from the pith in midsummer are evidence of borers. Terminal shoots become thickened, do not wilt, and their needles usually remain green but have a stunted "shaving brush" appearance (fig. 160). Sometimes terminal and lateral shoots are killed and turn orange-red. The mined pith is tightly packed with frass but the xylem and phloem are not damaged (fig. 161).

Similar damages-- No other pest produces the shortened, compacted appearance of affected terminals, without killing, as does the western pine shoot borer. Lateral shoots also may be killed by pine shoot blight, comandra blister rust, or other canker disease. Look for evidence of shoot borer mining in the pith.

References-- 2, 22, 71

Management Guide for Western Pine Shoot Borer

Figure 160. Shortened "shaving brush" appearance of shoot infested by western pine shoot borer.

Figure 161. Western pine shoot borer mining within the pith of an infested shoot.

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Pine Tip Moths From page 101

Genus: *Rhyacionia*

Hosts-- Pine species, especially ponderosa pine

Distribution-- Throughout much of western United States

Damage-- Larvae mine shoots and buds of young pines—especially damaging in plantations, even-aged natural stands, and ornamental plantings. Infested trees are often deformed and growth is retarded. Damage is unsightly, but seldom fatal. Trees from seedlings to saplings to about 25 feet tall are most commonly affected.

Identification-- Infested tips fade, occasionally curl, and eventually dry and turn reddish brown. Dead branch tips may have formations of dried pitch that developed as larvae bored into buds or developing shoots (fig. 162).

Several species of pine tip moths are native to western U.S. One has been introduced from Europe and is now prevalent and damaging in some areas. Adult moths are small, with a wingspan of ½- to ¾- inch. Wing coloration varies with species, but ranges from gray to mottled patterns of yellow and brown. Most species have a long "fringe" of scales on hind margins of wings. Larvae are also small, little more than ½-inch long when mature. In most species, larvae are yellowish with black head capsules. There is typically one generation per year in the northern part of their range. Winter is passed as a pupa in needle litter or upper soil layer. Adults emerge in late May to early June. Females deposit eggs on needles, buds, and developing shoots. Larvae bore into shoots where they feed during June and July. Larvae emerge from shoots in mid- to late-summer, drop to the ground, and pupate to overwinter.

Similar damages-- Damage may be confused with that caused by western pine shoot borer, terminal weevils, or some shoot pathogens. Tip moths almost always affect smaller shoots than shoot borers or terminal weevils.

References-- 22, 70

Management Guide for Pine Tip Moths

Figure 162. Pine terminal killed by pine tip moth. Note the resin at the attack site near the bud and the exit hole produced by the larva as it left the terminal to pupate in the duff.

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Table 6: Pine Branch and Terminal Damages Compared

From page 102

Pathogen or Insect	Hosts	Distinguishing Characteristics	Appearance
Western Gall Rust	Ponderosa and lodgepole pines	Golbose swelling; branch may be green or dead	
Peridermium Limb Rust	Jeffrey and ponderosa pine	Spindle-shaped swelling; roughened bark; yellow spore pustules	
Elytroderma Needle Cast	Ponderosa, Jeffrey; sometimes lodgepole, pinyon pines	Multiple tips affected in broom; discolored	
Pine Shoot Blight	Ponderosa pine	Individual tips killed; any size tree; branches may die	
Gout Pitch Midge	Ponderosa; sometimes lodgepole pine	Individual tips killed; saplings; pitchy gouts; red larvae	
Terminal Weevils	Lodgepole	Terminal Killed; trees up to 30' tall; feeding under bark and in pith	
Western Pine Shoot Borer	Pondersoa, Jeffrey, lodgepole pines	Terminal and lateral shoots stunted or killed; mined pith	
Pine Tip Moths	Ponderosa pine, other pines	Small shoots and buds killed; pitch at entry holes; mined pith	

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Aphids From page 103

Family: *Aphididae*

Hosts-- Most plant species may be hosts to aphids.

Distribution-- Found throughout range of hosts.

Damage-- Aphids have piercing mouth parts through which they feed on sap from nearly all parts of host plants--foliage, buds, flowers, fruits, twigs, and roots. Damage on needles may result in necrotic spots similar to some diseases or feeding by other insects. They excrete a sticky substance known as "honeydew" which is fed upon by ants and other insects. It may also provide a growth medium for black fungus molds.

Identification-- Aphids are small, soft-bodied, usually gregarious insects (fig. 163). Color ranges from almost colorless to green, yellow, or black. Most of those seen are wingless; however, winged adults may be observed at various times during the summer. Presence of sticky exudates and a large number of ants probably indicate aphids are also present.

Similar damages-- When severe, damage may resemble that caused by needle midges, other sucking insects, or needle diseases.

Management Considerations-- Managing native aphids

References-- 22, 70

Management Guide Aphids

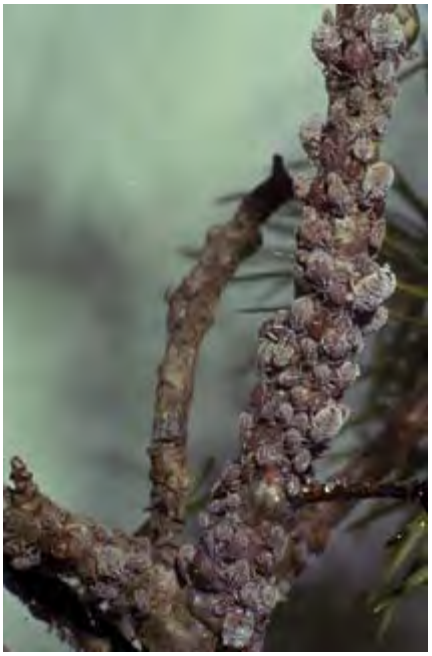

Figure 163. Aphids are small soft-bodied insects. Most are wingless and feed in mass as seen here.

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Juniper Twig Pruner From page 104

Styloxus bicolor (Champlain and Knull)
Family: Cerambycidae

Hosts-- Junipers.

Distribution-- Throughout range of host in Utah, Nevada and California.

Damage-- Larval mining in juniper twigs causes stunting of growth and leaf development. Twigs are severely damaged or killed. Repeated attacks and heavy populations can reduce growth but damage to juniper stands is generally minor. Small trees may be killed.

Identification-- Flagged branch tips which turn yellow, red or brown are easily observed in midsummer (fig. 164). The larval stage is the damaging and the one most often encountered. Adults lay eggs under bark of twigs and larvae initially feed under the bark. Twig growth is initially stunted and chlorotic; eventually turning yellow, red and brown as the twig is girdled and dies. Later the larvae bore into the pith where they continue to feed for the remainder of the larval period. Larvae are fleshy, cylindrical, elongate "grubs." They have a round head with the first few segments behind the head somewhat larger than the following segments.

Adults are about 1/2 inch long, brownish to black with orange-red heads. They are slender, delicate-appearing beetles with narrow, tapered wing covers (elytra) that fail to cover the entire abdomen.

Similar damages-- Twig girdling may resemble damage caused by feeding of adult cedar bark beetles. The juniper twig pruner, however, leaves a distinct round tunnel through the center of the stem.

References-- 6, 22

Management Guide Juniper Twig Pruner

Figure 164. Juniper twig pruner damage on juniper.

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Winter Desiccation From page 105

Hosts-- All conifers are susceptible although damage is most common in lodgepole pine, Englemann spruce, subalpine fir and Douglas-fir in this region.

Distribution-- Winter desiccation injury can occur anywhere, depending on winter weather pattern; however it is most common at high elevations and far northern latitudes.

Damage-- Foliage and sometimes terminals are killed. Repeated damage can lead to distortion of tree form (fig. 165).

Identification-- Injury occurs in winter when solar warming of southwestern aspect of tree crown causes leaves to transpire excessive moisture when roots are frozen and unable to replace moisture. Foliar damage may be predominantly on the southwest aspect of the crown. The portion of the crown covered by snow in winter is not damaged (fig. 166). Leaves turn red-brown in the spring and are shed during the summer. Branches and terminals may die as well leading to multiple stems and bushy tree forms.

Similar damages-- Needle diseases, terminal weevils and shoot borers can cause similar symptoms but without a tendency for the damage to end abruptly above the snow level or to be restricted to one aspect of the tree.

References-- 5, 35

Management Guide Winter Injury

Figure 166. Winter desiccation is common on high elevation sites.

Figure 165. Winter desiccation kills foliage and, sometimes, branches and terminals on portions of trees exposed above the snow.