

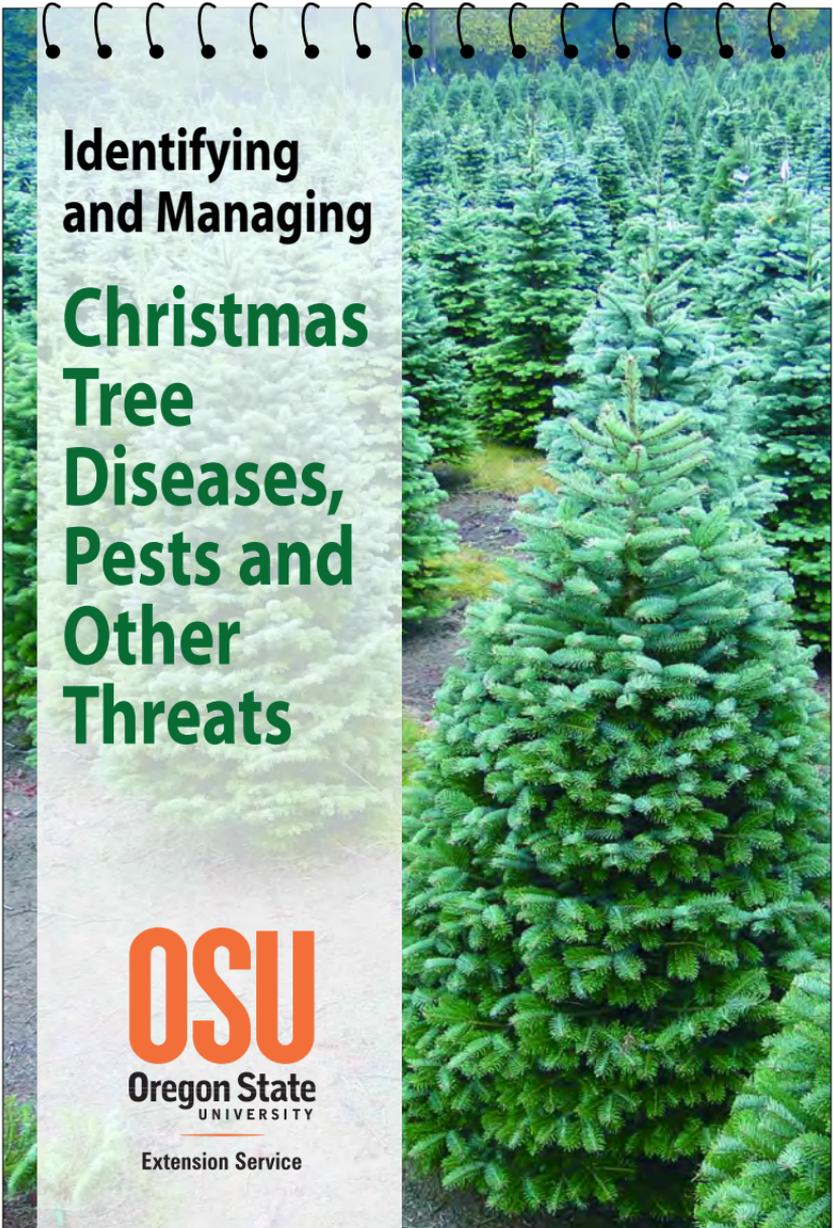
FRONT COVER:

Need title of book

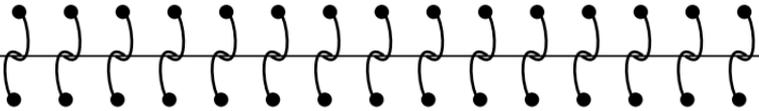
Logos or names of groups involved

Anything else that needs to be included

This is one of Chal's photos but I can change it out if you prefer.



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Title of handbook

CHRISTMAS TREE DISEASES

- Annosus Root Rot
- Phytophthora Root Rot
- Grovesiella Canker
- Rhabdocline Needle Cast
- Swiss Needle Cast
- Interior Needle Blight
- Pucciniastrum Needle rust
- Uredinopsis Needle rust
- Melampsora Needle rust
- Current Season Needle Necrosis (CSNN)



CHRISTMAS TREE INSECTS

- Root weevil
- Balsam twig aphid
- Conifer root aphid
- Balsam Woolly Adelgid
- Cooley Spruce Gall Adelgid
- Giant Conifer or Cinara aphid
- Douglas-fir Twig weevil
- Douglas-fir Needle midge
- Spruce spider mite
- Eriophyid mite



CHRISTMAS TREE DAMAGE

- Freeze Damage
- Heat Damage
- Drought
- Winter Injury
- Flooding
- Chemicals
- Algae/mold/lichens
- Mechanical and Animal Damage



CHRISTMAS TREE DISEASES



Annosus Root Rot

Heterobasidion annosum

Host:
Most Christmas tree species



SIGNS & SYMPTOMS

- Declining leader growth.
- Dark staining in the center of cut trees.
- Found in fields after multiple rotations without stumps removal.
- Dead trees near old stumps.
- Signs of the fungus: small white mounds on the bark near ground line.

WHERE TO LOOK

Trees planted near stumps

Causes of Similar Symptoms
Other root and canker diseases. Drought.

Annosus Root Rot MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
					SYMPTOMS-A						
									MONITORING B		
		MANAGEMENT-C							MANAGEMENT D		

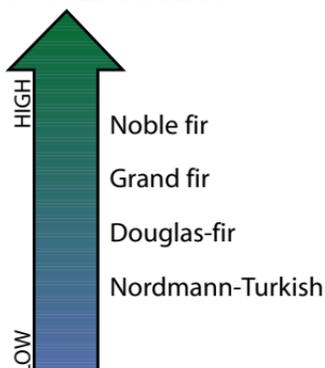
KEY: ■ A = Most likely during Stress ■ B = Examine stumps at harvest
■ C = Stump removal ■ D = Stump treatment

SCOUTING

Search carefully for signs of other root diseases once Annosus has been diagnosed, as they often occur together.



SUSCEPTIBILITY



MANAGEMENT OPTIONS

1. Consider stump removal prior to replant field.
2. Treat freshly cut stumps of healthy trees with borax to prevent infection by windborne spores.
3. Plant resistant species.

CHRISTMAS TREE DISEASES



Phytophthora Root Rot

Phytophthora spp.

Host:
Most Christmas tree species



SIGNS & SYMPTOMS

- Reduced or stunted growth
- Needle loss and lost of color
- Root decay
- Bleeding basal cankers
- Dead branches at the base

WHERE TO LOOK

Low-lying areas with poor water drainage.

Causes of Similar Symptoms
Other root diseases.
Drought.

Phytophthora Root Rot MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	
			SYMPTOMS-A									
			MONITORING-B									
			MANAGEMENT D					MANAGEMENT D				

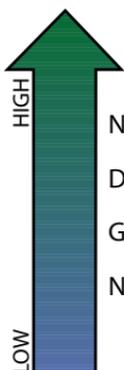
KEY: ■ A = Trees dying, yellowing, cankers, root rot ■ B = Scout for symptoms
■ C = Plant resistant species ■ D = Improve drainage

SCOUTING

1. Cut the tree and check cambium for presence of canker.
2. Dig roots and check for dark and rotten roots.



SUSCEPTIBILITY



Noble fir
Douglas-fir
Grand fir
Nordmann-Turkish

MANAGEMENT OPTIONS

1. Replant with resistant stock.
2. Improve field drainage (tiling, ditches).

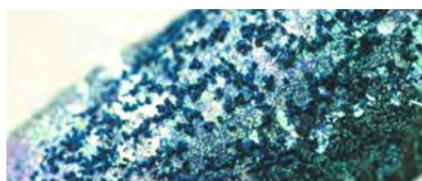
CHRISTMAS TREE DISEASES



Grovesiella Canker

Grovesiella abieticola

Host:
True firs



SIGNS & SYMPTOMS

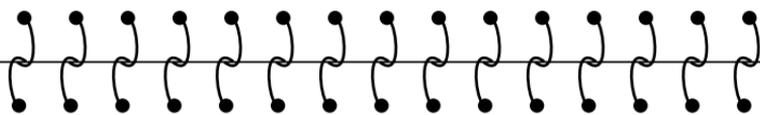
- Pronounced cankers with overgrowth.
- Cankers on the lower branches of the tree.
- Fungus produce round fruiting bodies (1/16 in) over the canker with a gray-black color.

Causes of

Similar Symptoms
Phytophthora root rot and stem canker.
Environmental stress and chemical damage.

WHERE TO LOOK

On branches between dead/living wood. Lower part of tree.



Grovesiella Canker MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	
			SYMPTOMS-A									
			MONITORING-B									
			MANAGEMENT-D									

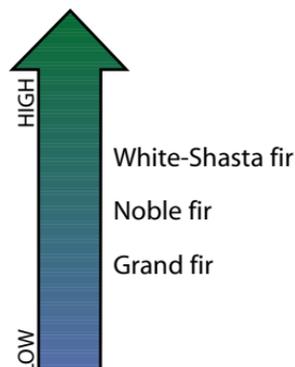
KEY: ■ A = Find dead branches with overgrowth, most likely during stress
■ B = Check first lower branches ■ C = Remove & destroy infected trees

SCOUTING

1. Search for slightly sunken dead tissue and cankers on dying branches.
2. Look for overgrowth.



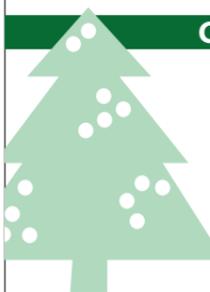
SUSCEPTIBILITY



MANAGEMENT OPTIONS

Cut off and destroy trees exhibiting symptoms.

CHRISTMAS TREE DISEASES



Rhabdocline Needle Cast

Rhabdocline weirii

A. K. Parker and J. Reid

Rhabdocline pseudotsugae Syd.

Host: Douglas-fir



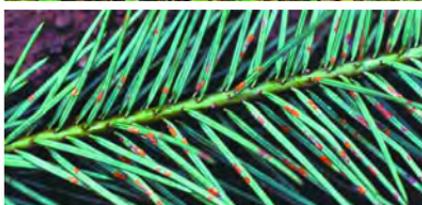
SIGNS & SYMPTOMS

Before bud break:

- Reddish-brown spots on upper surface of current-year needles; distinct border between diseased area and healthy, green tissue
- Swollen, light tan fruiting bodies on the underside of symptomatic needles

During bud break:

- Fruiting bodies rupture underside of needle epidermis, releasing mass of orange spores.



Causes of Similar Symptoms

Cooley spruce gall
adelgid • Swiss needle cast • Douglas-fir needle midge • Rust

WHERE TO LOOK

Common on Douglas-fir sources from east of the Cascades

Rhabdocline Needle Cast MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
			SYMPTOMS-A								
	MONITORING B										
			MANAGEMENT C								

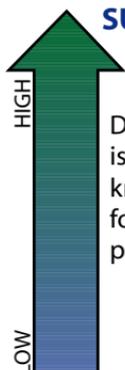
KEY: ■ **A** = Current needles with yellow spots ■ **B** = Look on underside of the needles ■ **C** = Fungicide protects emerging needles

SCOUTING

1. Search for symptoms prior to bud break, in late winter or very early spring.
2. Look for reddish-brown splotches on the upper needle surface. Only the newly emerging spring growth can become infected.



SUSCEPTIBILITY



Douglas-fir is the only known host for these pathogens

MANAGEMENT OPTIONS

1. At bud break spray fungicide to prevent infection.
2. Remove and destroy severely infected trees prior to bud break.
3. Plant resistant or tolerant tree varieties; avoid Douglas-firs from Rocky Mountain seed sources.

CHRISTMAS TREE DISEASES



Swiss Needle Cast

Phaeocryptopus gaumannii

Host:
Douglas-fir



SIGNS & SYMPTOMS

- Parallel rows of tiny, black fruiting bodies on the underside of older needles
- Yellowing or mottling of infected needles
- Trees lose interior needles, it looks thin.

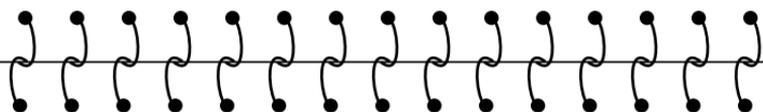
Causes of

Similar Symptoms

Rhabdocline needle cast • *Cooley spruce gall adelgid* • *Environmental stresses* • *Nutrient imbalances* • *Winter burn or drought damage*

WHERE TO LOOK

Areas with poor air movement. Field edges near Douglas-fir timber.



Swiss Needle Cast MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	SYMPTOMS-A										
		MONITORING B									
			MANAGEMENT C								

KEY: ■ **A** = Older needs yellow, fungal structures present ■ **B** = Look on underside of needles for black spots ■ **C** = Fungicides protect new growth

SCOUTING

1. Using a handlens look for parallel bands of tiny, black structures (0.1 mm) arising from the stomates on the undersides of mottled or brown-tipped needles.
2. Start scouting when trees enter their third growing season beginning in May.
3. Look in the lower part of the tree at older needles.
4. Pay particular attention to trees that appear off color or thin.



MANAGEMENT OPTIONS

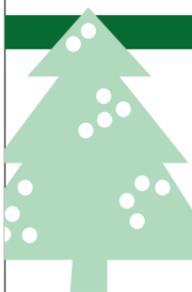
1. Improve air circulation in fields.
2. Spray protective fungicides at bud-break to 1.5" of new growth.
3. Plant alternative tree species.
4. Avoid planting field edges near timber.
5. Remove and destroy heavily infected trees prior to bud break.



SUSCEPTIBILITY

Douglas-fir only

CHRISTMAS TREE DISEASES



Interior Needle Blight

Several fungi species: *Mycosphaerella* spp.; *Phraeocryptopus nudus*; *Phyllosticta abietina*; *Toxosporium* spp.; *Rhizosphaera* spp.



Host: Noble and grand fir

SIGNS & SYMPTOMS

- Random to complete browning of older needles, mostly on lower branches.
- Symptomatic needles remain firmly attached to the branch.
- Small, black fungal fruiting bodies are present on the undersides of the needles.
- Yellowing and rapid shedding of interior needles.

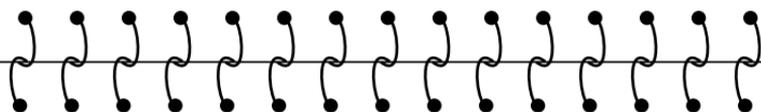


Causes of Similar Symptoms

Environmental stress often drought • Other needle disorders • Nutrient imbalances

WHERE TO LOOK

Older dense trees.
Areas with poor air circulation.



Interior Needle Blight MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
							SYMPTOMS-A				
								MONITORING B			
				MANAGEMENT C							

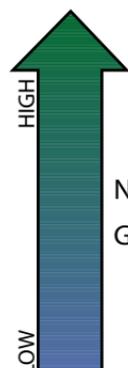
KEY: ■ **A** = Older needles dead but attached ■ **B** = Fungicides protects new growth ■ **C** = Check lower branches

SCOUTING

1. Observe trees in weedy sites, dense trees.
2. Areas near timber.



SUSCEPTIBILITY



Noble fir
Grand fir

MANAGEMENT OPTIONS

1. Promote better air circulation within plantations.
2. Improve weed control.
3. Basal pruning.
4. Produce "open" trees.

CHRISTMAS TREE DISEASES



Pucciniastrum Needle Rust

Pucciniastrum goeppertianum

Host: Shasta, noble and grand fir.
Alternate host *Vaccinium* spp.



SIGNS & SYMPTOMS

- Infected needles may have chlorotic areas.
- Sign of infection is the white colored tubelike fruiting structures on the lower surfaces of infected needles.
- Yellow-orange powdery spores are present on needles of all ages.

WHERE TO LOOK

Trees close to *Vaccinium* spp. (including huckleberry, wild blueberry and cranberry)

Causes of Similar Symptoms
Current season needle necrosis

Pucciniastrum Needle Rust MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
SYMPTOMS-A											
							MONITORING B				
			MANAGEMENT C				MANAGEMENT D				

KEY: ■ A = White colored tubelike structures on the lower structures of infected needles ■ B = Check for *Vaccinium*, the alternate host ■ C = Fungicides protect new growth ■ D = Remove & destroy alternate host

SCOUTING

1. Areas near alternate hosts.
2. Chlorosis on current season needles, often banded.



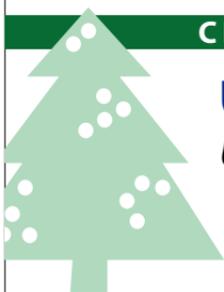
SUSCEPTIBILITY



MANAGEMENT OPTIONS

1. Remove and destroy alternate hosts near to plantation.
2. Spray protective fungicides on new developing shoots

CHRISTMAS TREE DISEASES



Uredinopsis Needle Rust

Uredinopsis pteridis

Host: Grand, White and Shasta fir.
Alternate host: bracken fern



SIGNS & SYMPTOMS

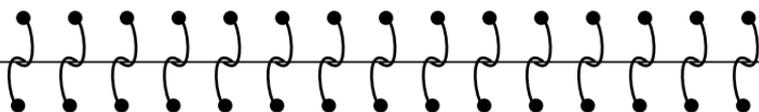
- Infected needles may have chlorotic areas.
- Infected needles present chlorotic to yellowing blotches on the upper surface.
- Needles of any age could be infected. No necrosis on needles.
- White-colored spores are produced from tubelike fruiting bodies underside of the needles.



WHERE TO LOOK

Trees near
bracken ferns

*Causes of
Similar Symptoms*
Current season
needle necrosis



Uredinopsis Needle Rust MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
SYMPTOMS-A											
				MONITORING B							
				MANAGEMENT C			MANAGEMENT D				

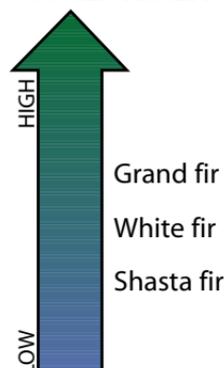
KEY: ■ A = Yellowing blotches on upper surfaces of infected needles
■ B = Tubelike structures underside of the needles
■ C = Fungicides protect new growth ■ D = Ferns controlled with herbicides

SCOUTING

1. Remove and destroy alternate hosts near to plantation.
2. Spray protective fungicides on new developing shoots



SUSCEPTIBILITY



MANAGEMENT OPTIONS

1. Pathogen depends on alternate host for survival.
2. Remove and destroy all bracken ferns in/next the field.
3. Spray protective fungicides on developing shoots.

CHRISTMAS TREE DISEASES



Melampsora Needle Rust

Melampsora occidentalis

Host: Douglas-fir.

Alternate host: black cottonwood, aspen and hybrids of *Populus* sp.



SIGNS & SYMPTOMS

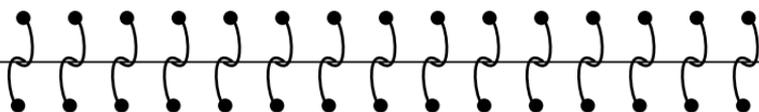
- Slightly chlorotic areas on infected new developing needles.
- Cream to yellow fruiting bodies two weeks after initial symptoms
- Discolored areas become necrotic and the needles shrivel and shed during the following 4-6 wks.



WHERE TO LOOK

Areas where trees are in proximity to overwintered diseased poplar leaves or any other alternate host

Causes of Similar Symptoms
Chemical damage



Melampsora Needle Rust MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
				SYMPTOMS-A							
				MONITORING B							
			MANAGEMENT C								

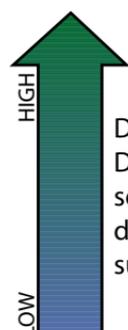
KEY: ■ A = New needles with discolored areas
■ B = Check under new needles for orange structures
■ C = Fungicides protect new growth

SCOUTING

1. Scout yellowing on needles especially current season.
2. Look for necrosis in discolored areas of the needles and yellow-orange pustules.

picture?

SUSCEPTIBILITY



Different Douglas-fir seed sources differ in susceptibility

MANAGEMENT OPTIONS

1. Spray protective fungicide on early stages of shoot development, mid-May to early June.
2. Removal of susceptible poplar hosts near douglas-fir plantation.
3. Select a less susceptible Douglas-fir seed source.

CHRISTMAS TREE DISEASES



Current Season Needle Necrosis (CSNN)

The cause is currently unknown

Host: Noble and grand fir



SIGNS & SYMPTOMS

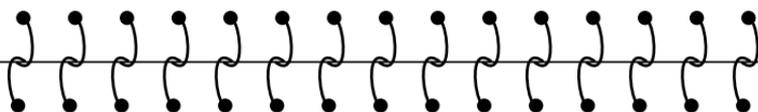
- Tan discolored bands on random needles at the tip of the needle or the entire needle. Affected portions turn reddish brown, then needles are shed.
- Symptoms present on newly developed needles.
- Secondary organisms can colonize the necrotic tissue. Fruiting bodies could be observed on symptomatic needles during late summer and fall.



WHERE TO LOOK

Valley sites and areas prone to high temperatures during shoot elongation

Causes of Similar Symptoms
Needle rust.
Environmental stress.



Current Season Needle Necrosis MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
SYMPTOMS-A											
						MONITORING B					
	MANAGEMENT C										

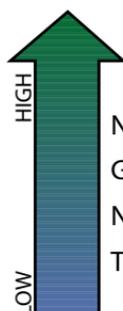
KEY: ■ A = Needles dead from mid point to tip ■ B = Symptoms develop after high temperatures ■ C = Plant resistant species

SCOUTING

1. First symptomatic needles in branches in the upper portions on the tree on noble fir, on grand fir damage can involve entire tree.
2. Examining symptomatic needles during late summer and fall.



SUSCEPTIBILITY



HIGH
Noble fir
Grand fir
Nordmann
LOW
Turkish

MANAGEMENT OPTIONS

1. Plant resistant species.
2. Shading trees during shoot elongation may reduce symptoms.
3. Spray treatments have shown marginal results.

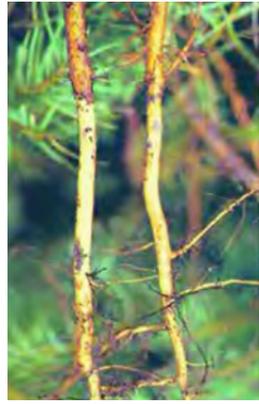
CHRISTMAS TREE PESTS



Root Weevil

Otiorhynchus sp.

Host: Douglas-fir, noble, grand, most Christmas tree species



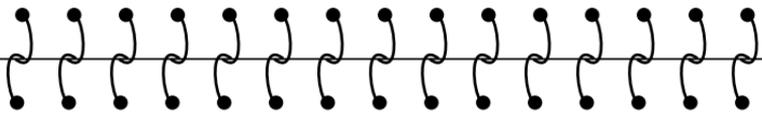
SIGNS & SYMPTOMS

- Reduced plant growth
- Yellow needles and premature needle loss
- Scalloping or notching along needle margins
- Larvae are legless grubs, bend their bodies in the shape of a letter "C", and/or root damage

Causes of Similar Symptoms
 Root problems • Environmental stress

WHERE TO LOOK

New fields, edges



Root Weevil MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
					SYMPTOMS-A						
			MONITORING B		MONITORING C						
			MANAGEMENT D		MANAGEMENT E						

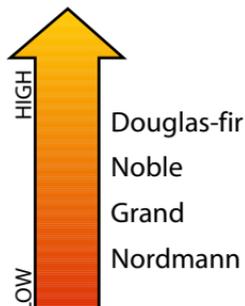
KEY: ■ A = Notched needles ■ B = Larvae ■ C = Adults
 ■ D = Biocontrol? ■ E = Insecticide, foliar sprays

SCOUTING

1. Monitoring for adult weevils late May and early June, especially on cloudy days under leaves.
2. Scout for larvae on the roots and crowns of host plants between April-May.



SUSCEPTIBILITY



MANAGEMENT OPTIONS

1. At the first appearance of adults apply first chemical control and repeat 4-week intervals until no more adults are found.
2. Site preparation prior to planting if weevils are a problem (fallow, discing, and habitat disruption).

CHRISTMAS TREE PESTS



Balsam Twig Aphid

Mindarus abietinus

Host: Balsam fir, Fraser, Grand and white firs



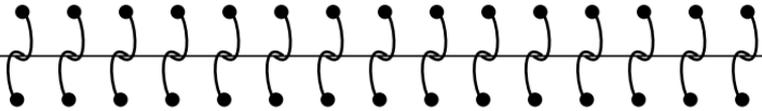
SIGNS & SYMPTOMS

- Curled, twisted needles on current year's growth.
- Stunting needles
- Needle loss
- Black sooty mold on stem, trunk and needles, and presence of stinging insects (bees and yellow jackets)

WHERE TO LOOK

Pockets in field

Causes of Similar Symptoms
Different aphid species



Balsam Twig Aphid MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
					SYMPTOMS-A						
			MONITORING B								
		MANAGEMENT C									

KEY: ■ A = Needle distortion, stunting and loss ■ B = Adults
■ C = Insecticide spray

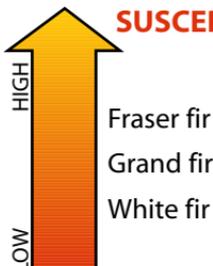
SCOUTING

1. Monitoring for egg hatch by late April using a hand lens (15x).
2. Aphids have two distinct forms, a relatively large bluish gray stem mother and the smaller greenish yellow, offspring maybe covered by a fine powdery wax.
3. Scout small oval eggs coated with waxy rods, pale tan, by spring they appear to be silvery black.
4. Use beating sheet or black board, 15 trees/acre.

MANAGEMENT OPTIONS

1. Encourage natural predators and parasitoids like yellow jackets, lacewings, earwigs, lady beetles and their larvae, ants, predatory thrips, predaceous midges. Parasitoids as Aphidius wasps.
2. Pesticide should be applied after eggs hatch, but before bud break. Use of synthetic pyrethroids may cause outbreak of secondary pests, such as rust mites due to eliminating of natural predators.

SUSCEPTIBILITY



CHRISTMAS TREE PESTS



Conifer Root Aphid

Prociphilus americanus and other *P. spp.* and *Rhizomaria piceae*

Primary host: Ash • **Secondary host:** Fraser fir, Douglas-fir, Noble and Grand



SIGNS & SYMPTOMS

- General decline of trees, and eventual dying of the leader and branch tips.
- Stunted young (stressed) trees.
- *Prociphilus* sp feed directly on conifer roots and often are attended by ants. These ants may defend the aphid from natural enemies and may move individual aphids around.
- *Rhizomaria* sp are associated with fine conifer roots and mycorrhizae. These aphids are not tended by ants.

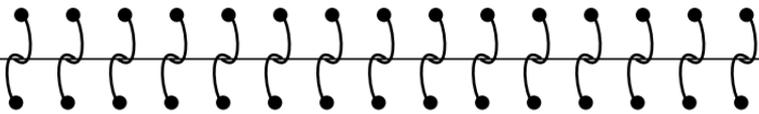


WHERE TO LOOK

Pockets

Causes of Similar Symptoms

Nutrient deficiencies • Environmental stress



Conifer Root Aphid MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
SYMPTOMS-A											
				MONITORING B							
				MANAGEMENT C							

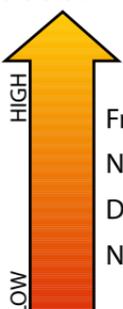
KEY: ■ **A** = Trees declining, drastic growth reduction ■ **B** = Ants around trunks and roots ■ **C** = Insecticide that can be applied as a root drench

SCOUTING

1. Scout for ants around the trunks and roots.
2. Search for root aphids on uprooted trees.



SUSCEPTIBILITY



Fraser fir
Noble fir
Douglas-fir
Nordmann fir

MANAGEMENT OPTIONS

1. Keep trees healthy and free of pests, disease, and cultural problems.
2. Obtain seedlings from nurseries that have no root aphids.
3. Systemic insecticides available

CHRISTMAS TREE PESTS



Balsam Woolly Adelgid

(exotic pest from Europe)

Adelges Piceae

Host: Balsam, Fraser, noble, Shasta, and grand firs



SIGNS & SYMPTOMS

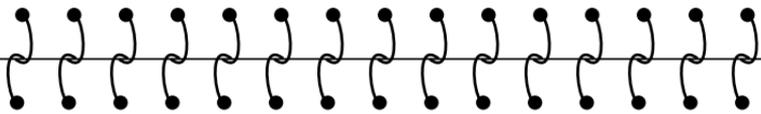
- Yellow needles and premature needle loss
- Flat top or crooked terminal
- Gouting (swelling) around buds and internodes
- Stiff, inflexible trunk and large lateral branches
- White, cottony masses on trunk and large branches
- Dead shoots or branches



WHERE TO LOOK

Pockets of trees in a field

Causes of Similar Symptoms
Root problems • Severe aphid damage



Balsam Woolly Adelgid MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	
SYMPTOMS-A												
			MONITORING B		MONITORING C							
				MANAGEMENT D								

KEY: ■ A = Swollen branch nodes and terminals ■ B = Eggs-cottony tufts
■ C = Crawlers visible with hand lens ■ D = Insecticide spray at/near budbreak

SCOUTING

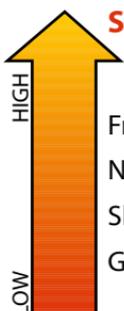
1. Scout at waist height for swollen areas in branches and main trunk (white, cottony masses).
2. Look for flat tops on trees or dark reddish rings in wood of cut stumps.
3. Examine stumps from the current season for evidence of scar tissue.



MANAGEMENT OPTIONS

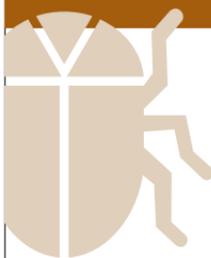
1. Use a high-pressure sprayer during the first generation-crawler stage.
2. If the adelgid is found, treat the field prior to bud break of the following season.
3. Cut and burn heavily infested trees. Do not cut during crawler activity.
4. Clear-cut infested blocks. Do not leave infested trees in the field.

SUSCEPTIBILITY



Fraser fir
Noble fir
Shasta fir
Grand fir

CHRISTMAS TREE PESTS



Cooley Spruce Gall Adelgid

on Douglas-fir
Adelges cooleyi

Host: Douglas-fir (needle injury)
Alternate hosts: Colorado blue spruce and occasionally other spruces (galls)



SIGNS & SYMPTOMS

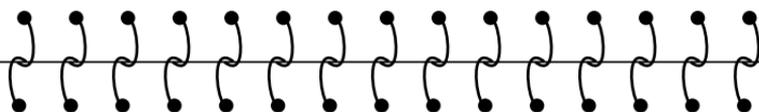
- Yellow spots on the needles
- Needles with bends or crooks
- Small, white, cottony balls on the underside of needles or pepper sized crawlers on new needles
- Premature needle drop



WHERE TO LOOK

Current season needles

Causes of Similar Symptoms
Rhabdocline needle cast • *Douglas-fir needle midge*



Cooley Spruce Fall Adelgid on Douglas-fir MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
SYMPTOMS-A											
			MONITORING B								
			MANAGEMENT D								

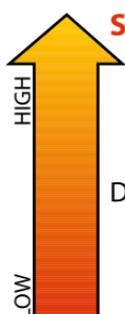
KEY: ■ **A** = Yellow spots on needles ■ **B** = Chlorotic spots, distortion and crawlers on new needles ■ **C** = Insecticide spray before cottony stage

SCOUTING

1. Scout for overwintering nymphs on the underside of needles.
2. Examine the undersides of needles on inner branches as well as last year's growth.
3. Control for 2 years before harvest to have damage-free needles.

MANAGEMENT OPTIONS

1. Remove any mature spruce or Douglas-fir that may be sources of infestation.
2. **Early spring/late fall:** dormant oil can control overwintering nymphs before new growth starts.
3. **Spring insecticide:** First application after nymphs/immature females begin to swell but before they produce white, waxy threads to cover themselves. A 2nd application in 7-10 days may be needed.
4. **Fall insecticide:** A single spray should be applied in late September or October to control the exposed nymphs and immature females before overwintering.



SUSCEPTIBILITY

Douglas-fir

CHRISTMAS TREE PESTS



Giant Conifer or Cinara Aphid

Cinara spp.

Host: All conifers support one or more species of Cinara



SIGNS & SYMPTOMS

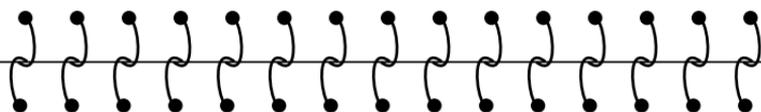
- Trees are blackened by sooty mold that grows on aphid honey dew. Particularly leaders.
- Aphid feeding can cause stunting on terminals, yellowing of needles, and in severe cases death of terminals.
- These aphid are often tended by ants collecting honey dew.
- Ants may do damage chewing directly on trees.



WHERE TO LOOK

Random, black "soot" on leaders.

Causes of Similar Symptoms
Other aphids



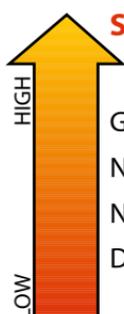
Giant Conifer or Cinara Aphid MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	
SYMPTOMS-A												
MONITORING B		MONITORING C										
				MANAGEMENT D								

KEY: ■ A = Stunting of terminals ■ B = Overwinter eggs
■ C = Adults ■ D = Insecticide spray

SCOUTING

1. Monitoring colonies for the conspicuous honeydew, and sooty mold beginning in early spring.
2. Only individual trees are infested heavily to warrant control.
3. Pest can be found any time in the year. Scouting with naked eyes. Scout for black eggs in row on needles in early spring.
4. Look for wasp presence and purple stains when handling trees as indicator of aphid presence.



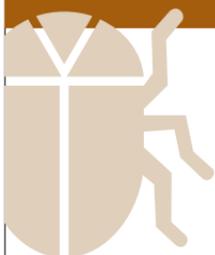
SUSCEPTIBILITY

Grand fir
 Noble fir
 Nordmann fir
 Douglas-fir

MANAGEMENT OPTIONS

1. Spot treatment with a labeled chemical, to avoid disrupting natural populations of predators and parasitoids.
2. Squish colonies by hand.

CHRISTMAS TREE PESTS



Douglas-fir Twig Weevil

Cylindrocopturus fumissi

Host: Douglas-fir
(rarely true firs)



SIGNS & SYMPTOMS

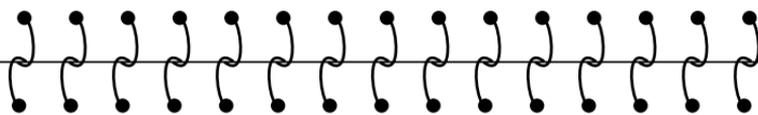
- Larvae bore through the bark to the wood surface. At maturity they tunnel deeper, into the pith.
- Feeding damage results in the death of twigs and branches.
- Needles die, turning a reddish brown.
- Douglas-fir seedlings may exhibit deformation of branches and poor growth. Damage is usually inconspicuous on older trees.



WHERE TO LOOK

Dry sites with stressed trees. Douglas-fir weakened by environmental stress or improper planting.

Causes of Similar Symptoms
Phomopsis canker • Botrytis blight • Bark beetles • Environmental stresses: drought, winter damage



Douglas-fir Twig Weevil MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
SYMPTOMS-A											
MONITORING B				MONITORING C		MONITORING D					
						MANAGEMENT E		MANAGEMENT F			

KEY: ■ A = Death of twigs & branches ■ B = larvae bore through the bark ■ C = Pupa stage ■ D = Adults ■ E = Insecticide targeting emerging adults ■ F = Remove dead branches

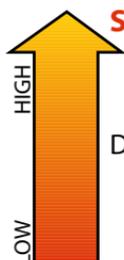
SCOUTING

1. Scout for feeding galleries on the surface of the wood.
2. Look for 1 mm diameter adult weevil exit holes.
3. Concentrate scouting on dead or dying twigs near the top of the tree, especially the larger diameter branch stubs left after pruning.



MANAGEMENT OPTIONS

1. Target control, if needed, against emerging adults from July to early August.
2. Maintain vigorous growth using proper cultural procedures.
3. Cut out and destroy infested trees.



SUSCEPTIBILITY

Douglas-fir

CHRISTMAS TREE PESTS



Douglas-fir Needle Midge

Contarinia pseudotsugae

Host: Douglas-fir



SIGNS & SYMPTOMS

- Infested needles appear swollen and chlorotic where maggots are active. Later, after emergence, needles can develop a reddish brown appearance.
- Premature needle loss.



WHERE TO LOOK

Sites with native Douglas-fir trees nearby.

Causes of Similar Symptoms
Rhabdocline needle cast • Cooley spruce gall adelgid

Douglas-fir Needle Midge MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
					SYMPTOMS-A						
		MONITORING B									
			MANAGEMENT C			MANAGEMENT D					

KEY: ■ A = Swollen & chlorotic needles ■ B = Place emergence traps
■ C = Apply spray control measures based on trap catch ■ D = Remove infested trees

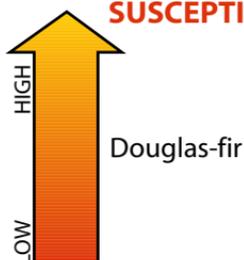
SCOUTING

1. Remove overgrown Douglas-fir from the perimeter of the block.
2. Monitor for adult midge emergence to effectively time control applications.
3. Place several traps per field, check frequently, and count the midges.
4. Place emergence traps under the north side of previously infested trees by April.
5. Continue monitoring until no midges are present for several days.
6. Scout in August for infestation.

MANAGEMENT OPTIONS

1. Encourage and protect natural predators.
2. Remove heavily infested trees in early fall before larvae exit the needles.
3. Base insecticide application on collection of adults in emergence trap or field scouting.
4. Chemicals will be effective only against adults.
5. First application should be made as trap or weather dictate, often at bud swell to bud break.

SUSCEPTIBILITY



CHRISTMAS TREE PESTS



Spruce Spider Mite

Oligonychus ununguis

Host: Fraser fir is highly susceptible, Noble and Douglas-fir are moderately susceptible



SIGNS & SYMPTOMS

- Rusty or bronzed needles; damage may appear most severe during hot, dry weather.
- Premature needle drop.
- Damage heaviest at the bottom inside of the tree; damaged needles will not recover from the chlorophyll lost as a result of mite feeding.
- Fine webbing on needles and twigs; cast skins, dead mites, dirt, and other debris trapped in the silk.

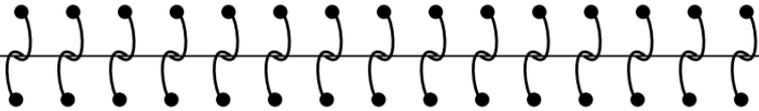


WHERE TO LOOK

Infestations frequently occur in pockets, not distributed evenly through field • Along dusty roads, where other insecticides have been used

Causes of Similar Symptoms

Rust mites (spruce and fir) • Rhizosphaera needle cast (spruce) • Environmental stress • Air pollution • Spruce aphids



Spruce spider mite MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	
				SYMPTOMS-A								
	MONITORING B	MONITORING C		MONITORING D								
	MANAGEMENT E			MANAGEMENT F								

KEY: ■ A = Foliage yellowing & bronzing ■ B = Overwinter eggs ■ C = Eggs hatch ■ D = Adult mites ■ E = Oils spray ■ F = Miticides spray

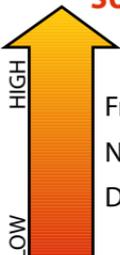
SCOUTING

1. A 15-20X hand lens or small microscope is required to view spider mites and eggs.
2. Eggs have a single hair like stripe on the top, which can be used to distinguish from other spider mite eggs.
3. Look for damage about halfway up the canopy and in the interior part of the tree.
4. Look for eggs during the winter and early spring, before April.
5. Scout for active forms by holding a light-colored surface (paper, paper plate) beneath a branch or using beating sheet.

MANAGEMENT OPTIONS

1. A decision to control should be based on scouting.
2. If large number of eggs are found in February or March, consider an application of horticultural oil.
3. Chemical application other than oils are applied in May or early June; however, exact timing will depend on geography, weather.

SUSCEPTIBILITY



Fraser fir
Noble fir
Douglas-fir

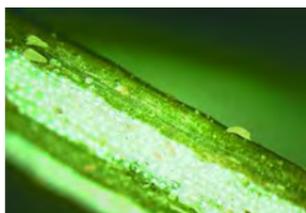
CHRISTMAS TREE PESTS



Eriophyid Mite

Trisetacus spp., *Epitrimerus pseudotsugae*, and *Nelepellia ednae*

Host: Noble, Douglas-fir and grand fir



SIGNS & SYMPTOMS

- Damaged needles can be either yellowing and stunting of new needles, or yellowing and curling of more developed needles on new shoots.
- Affected needles later turn brown, die, and drop from the shoot, leaving naked branch tips.

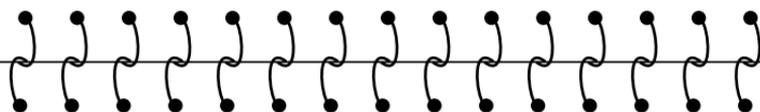


Causes of Similar Symptoms

Damage caused by environmental stress • Chemical and nutrient imbalances

WHERE TO LOOK

Pockets



Eriophyid mite MANAGEMENT CALENDAR

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
		SYMPTOMS-A									
		MONITORING B						MONITORING C			
		MANAGEMENT D						MANAGEMENT E			

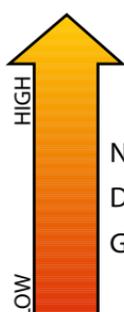
KEY: ■ A = New needles yellowing & stunting ■ B = Use a 15-20X hand lens ■ C = Eriophyid mites are smaller than mites ■ D = Miticide spray labeled for eriophyid ■ E = ?

SCOUTING

1. Needles at the branch tip may appear white-flecked or fuzzy when population are high.
2. Look for needle vagrants during late April and early May.



SUSCEPTIBILITY



Noble fir
Douglas-fir
Grand fir

MANAGEMENT OPTIONS

1. Begin chemical control measures when new mites emerge (April-May).
2. Use of mineral or paraffin oil.

CHRISTMAS TREE THREATS



Frost Damage

Host: All Christmas tree species, especially early bud breaking sources

CAUSES

- Results from freezing temperatures in the spring when new growth has started to appear.

SIGNS & SYMPTOMS

- Frost damaged foliage is evident within a few days of damage.
- Damage is characterized by browning or wilting of new shoot growth.
- It looks severe when it first occurs, most trees are able to recover.
- On very succulent growth shoots may appear wilted.
- Needles may vary from a pale, water-soaked color to brown or red depending on degree of damage and species.
- Differences in bud break will make some trees show damage, while other will escape injury.



MANAGEMENT OPTIONS

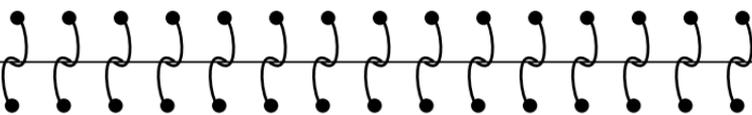
- Some trees might need some corrective pruning if damage is especially severe.
- Damaged growth can be removed during shearing.
- On frost prone sites, some species/sources should be culled or avoided.



WHERE TO LOOK

Trees that break bud early • Low areas or frost pockets where cold air collects.

Causes of Similar Symptoms
Botrytis shoot blight



CHRISTMAS TREE THREATS



Winter Injury

Host: Any Christmas tree species, especially nonadapted seed sources or exotic species

CAUSES

- Occurs as a direct result of cold temperatures or desiccation.
- Plants cannot obtain water from frozen soil or move water through frozen tissues.

SIGNS & SYMPTOMS

- Appears as damage to needles, bark and bud tissues.
- Symptoms may not be evident until warmer conditions later in spring.
- In some cases, only the needles may be damaged, turning a reddish brown.
- In more severe cases, damage may result in dead of buds or shoots.
- In the spring, may appear as dying and reddening of the needles, stems and buds on the entire upper portion of the tree or random damage.



MANAGEMENT OPTIONS

- Sources adapted to extremely cold areas may experience winter injury or frost damage as they begin growth too soon in mild winters.
- Some locations and/or seed sources/species are more prone than others.



WHERE TO LOOK

South to southwest side of the tree or on tissue above snow cover.

Causes of Similar Symptoms
Drought

CHRISTMAS TREE THREATS



Drought

Host: All Christmas tree species can be stressed by drought. Newly planted trees are most susceptible, especially Noble fir.

CAUSES

- Depleted soil moisture into fall.
- Late season planting may compromise root growth.

SIGNS & SYMPTOMS

- Wilting of new growth, top dieback, tree death.
- Loss of interior needles, shortened needles, needle tip dieback, overall slow growth, and death tree.
- Symptoms generally start at the top of the tree and continue downward.
- Damage may occur over several years.
- Trees weakened by drought, may lead to other problems, especially insects and diseases.



MANAGEMENT OPTIONS

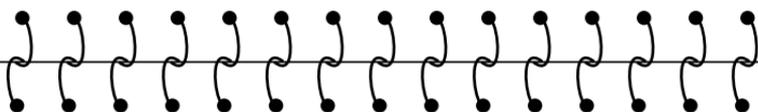
- Conserve existing water
- Eliminate competing vegetation by weed and brush control
- Assess the type of soil where trees are going to be planted
- Plant drought tolerant species
- Supplemental irrigation is a final solution



WHERE TO LOOK

Newly planted trees • Plants growing on gravelly or sandy soils.

Causes of Similar Symptoms
Gopher or root weevil problems • Winter damage



CHRISTMAS TREE THREATS



Heat Damage

Host: All Christmas tree species can be damaged by heat.

CAUSES

- Extreme high temperatures from intense sunlight can damage all Christmas trees, especially during bud break.

SIGNS & SYMPTOMS

- High temperatures during bud break can damage emerging shoots.
- Groups of needles on a shoot quickly turn reddish brown.
- High temperatures later in the season can damage needles and shoots, causing the entire tree to appear burned/reddened.
- Heat, drought and sunscald damage are closely related.



MANAGEMENT OPTIONS

- Protect young seedlings using shade devices, such as shingles and cards.
- In older plantings try to maximize soil moisture levels.



WHERE TO LOOK

South or southwest side of the trees

Causes of Similar Symptoms
Current season needle necrosis • Exhaust damage • Chemical injury

CHRISTMAS TREE THREATS



Yellow-green Mottle Syndrome

Host: Douglas-fir

CAUSES

- Unknown, but may be genetic.



SIGNS & SYMPTOMS

- Needles of all ages are affected by yellow-green mottle syndrome.
- Yellow-green blotches may be small or may cover the entire needle, but the midrib is never affected.
- Mildly affected needles have small or large blotches on only one side of the midrib.
- Severely mottled needles are entirely yellow with a dull green midrib.
- Affected needles usually fall off the trees, sometimes causing severe defoliation.
- Trees sometimes grow out of the syndrome in two or three years.



MANAGEMENT OPTIONS

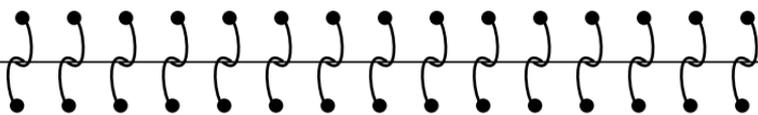
- Sprays are not effective.
- Give affected trees a chance to outgrow the mottling.
- Remove and destroy trees that are affected every year.



WHERE TO LOOK

Initial symptoms after shoot elongation

Causes of Similar Symptoms
Mite damage • Nutrient deficiency • Spray damage



CHRISTMAS TREE THREATS



Interior Needle Loss

Host: All Christmas tree species, especially Noble fir



CAUSES

- Environmental stress, such as low light levels or moisture stress can accelerate the yellowing and dropping of older needles.

SIGNS & SYMPTOMS

- Loss of interior older needles.
- In late summer and early fall, older needles turn yellow prior shedding. They are easily dislodged from the stems.

MANAGEMENT OPTIONS

- Use mechanical shakers to minimize the problems on harvested trees.



WHERE TO LOOK

Interior/older needles

Causes of Similar Symptoms
Interior needle blight syndrome on noble & grand fir • Other fungal needles casts

CHRISTMAS TREE THREATS



Chemical Sprays: 2, 4-D and triclopyr

Host: True firs are highly susceptible to these chemicals

CAUSES

- 2,4-D and triclopyr are hormone-type herbicides used to control annual and perennial broadleaf weeds. These products are translocated throughout the plant in both xylem and phloem.



SIGNS & SYMPTOMS

- Damage may appear as distorted plant parts including twisting and curling on new growth.
- Swollen shoot tips are associated with 2,4-D injury.
- Severity of damage depends on amount applied, timing, and if other herbicides are present in the mixture.
- Damage also may occur from drift of the pesticide or pesticide vapors.

MANAGEMENT OPTIONS

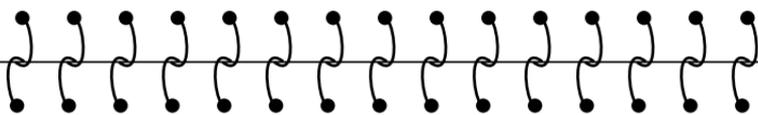
- Soil drainage pattern and texture will influence movement of products.
- If use a chemical follow label directions as to the rate, timing and tree species.
- Calibrate application equipment properly.
- Avoid sprays on hot days.



WHERE TO LOOK

New growth is more susceptible

Causes of Similar Symptoms
Shoot dieback



CHRISTMAS TREE THREATS



Chlorothalonil (Bravo)

Host: All Christmas tree species, especially Noble fir

Fertilizer Burn

Host: All Christmas tree species

CAUSES

CHLOROTHALONIL

- Chlorothalonil is a broad-spectrum protectant that controls many fungal diseases

FERTILIZER BURN

- Nutrient excesses resulting from inappropriate or excessive fertilizers can damage or kill trees



SIGNS & SYMPTOMS

CHLOROTHALONIL

- New foliage looks "burned" as a result of an application of chlorothalonil fungicide.
- Damaged tissue appears sunken/spotty.

FERTILIZER BURN

- The tips of newly developing needles can exhibit a reddish brown discoloration or necrosis.
- All of the needles will tend to show similar levels of damage, unlike a fungal disease, in which only a few random needles are affected.

MANAGEMENT OPTIONS

CHLOROTHALONIL

- Carefully calibrate spray equipment and check that spray distribution patterns cover the lower tree crowns where the foliar fungi proliferate.
- Fungicides must be applied thoroughly during infection period(s) to prevent infection.

FERTILIZER BURN

- Monitor tree color and conduct tissue test.
- Calibrate applicators.



WHERE TO LOOK

CHLOROTHALONIL: New growth
FERTILIZER BURN: Damage pattern follows application area. Particular attention to newly planted seedlings and small trees.

Causes of Similar Symptoms
Chlorothalonil: Any other type of spray damage.
Fertilizer burn: Chemical injury.

CHRISTMAS TREE THREATS



Glyphosate (Round Up)

Host: Any Christmas tree species

CAUSES

- Glyphosate is a nonselective herbicide which interferes with amino acid synthesis. It is translocated throughout the plant via both xylem and phloem.

SIGNS & SYMPTOMS

- Applied prior to budbreak, can stunt new growth, and cause short needles and pale green foliage.
- Applied after budbreak, rapid death of new needles. Foliage appears burned or desiccated.



MANAGEMENT OPTIONS

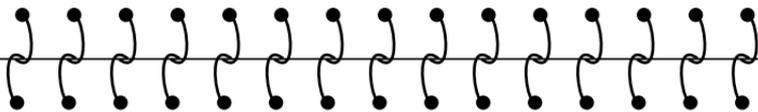
- Spray timing and knowledge of product options/usage critical.
- Carefully read all label instructions and precautions prior to purchasing and applying these herbicides.



WHERE TO LOOK

Plants part hit by sprays

Causes of Similar Symptoms
Botrytis



CHRISTMAS TREE THREATS



Triazines (atrazine, simazine, velpar and others)

Host: Douglas-fir and container growth seedlings are more sensitive to damage

CAUSES

- Triazines are nonselective herbicides that are used for control of annual and perennial grasses and broadleaf weeds. These products are translocated in plants in the xylem.

SIGNS & SYMPTOMS

- Damage appears as needle tip and margin chlorosis or necrosis.
- Damage may be more pronounced with higher temperatures.
- Severe damage on seedlings may show yellow or pink needles prior to their death.



MANAGEMENT OPTIONS

- Spray timing and knowledge of product options/usage critical.
- Carefully read all label instructions and precautions prior to purchasing and applying these herbicides.



WHERE TO LOOK

Soil drainage pattern and texture will influence movement of products • Newly planted container seedlings, light textured soils.

Causes of Similar Symptoms
Current season needle necrosis

CHRISTMAS TREE THREATS

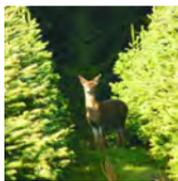


Vertebrates Damage

Host: All Christmas tree species

CAUSES

1. Deer and Elk Damage
2. Voles and mice



SIGNS & SYMPTOMS

- a) Antler rubbing: occurs on trees with open internodal spaces. Often bark is scrapped off, producing long-lasting injury.
 - b) Foliage feeding: damage involves leaders and upper branches, usually to current season foliage.
2. Small feeding marks around the stem of seedlings. A decrease in tree growth results from the sublethal feeding injuries, but smaller trees may die if completely girdled.

MANAGEMENT OPTIONS

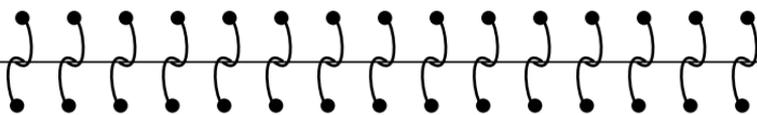
1. Fencing, repellents, individual tree protection.
2. Maintaining weed control in the rows and particularly around the base of the tree. The bare ground is not attractive to the rodents and rabbits, and exposes them to predators.



WHERE TO LOOK

Droppings and tracks can aid identification • Stem of seedlings, just above ground level, especially during winter and early spring

Causes of Similar Symptoms
Equipment damage • Weevil damage



CHRISTMAS TREE THREATS



Vertebrates Damage

Host: All Christmas tree species

Damage from deer and elk is common on Douglas-fir in the spring, and Fraser & Nordmann fir in winter and spring

CAUSES

3. Rabbits
4. Birds



SIGNS & SYMPTOMS

- Rabbits will feed on young trees. Shoots cut off at a 45-degree angle or girdling at the base are symptoms of rabbit feeding. They will feed higher on the tree and may remove significant amounts of bark.
4. Broken tree tops, from May to July when the new tops are just elongating.

MANAGEMENT OPTIONS

3. Maintaining weed control in the rows and particularly around the base of the tree. The bare ground is not attractive to the rodents and rabbits, and exposes them to predators.
4. Possible solution is to place poles or perches throughout the fields at a height above the trees. Frightening devices may help.



WHERE TO LOOK

Stems of young trees 2 feet from the ground • Tall trees are the most vulnerable

Causes of Similar Symptoms
Mice & voles damage • Equipment damage

CHRISTMAS TREE THREATS



Mechanical Damage

Host: All Christmas tree species

CAUSES

- Growing Christmas trees requires the use of many different types of equipment and tools. If not properly used, these may actually damage the trees.



SIGNS & SYMPTOMS

- **Equipment Damage:** Spray booms, tool bars, rototillers, and mowers can damage trees. As the trees grow, it becomes harder for the equipment to travel down the rows without causing damage. Equipment damage results from the tractor and its tires and implements. Planting equipment may also lead to tree injury. If the planting depth is not correct, the taproot may curve upward instead of straight down.
- **Shearing Damage:** If a shearing knife is not used properly or is not sharp, branches will not be cut cleanly and partial cuts or broken branches may result. This results in dead or "flagged" branches.

MANAGEMENT OPTIONS

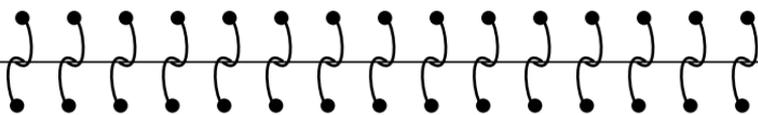
- Once damage has occurred, little can be done to correct the problem
- To reduce damage when using a shearing knife, always use a sharp blade and swing with enough force to ensure minimal uncut branch ends
- Equipment with tire shields may minimize damage



WHERE TO LOOK

Trees at end of rows • Lower branches on trees, at equipment level

Causes of Similar Symptoms
Vertebrates damage • Drought



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