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CHRISTMAS TREE PEST MANUAL

PESTICIDE SAFETY EDUCATION PROGRAM

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Christmas tree plantation in Farmington, New Hampshire. Credit: Conley Tree Farm.

Foreword

This manual was prepared for the New Hampshire Pesticide Safety Education Program as part of the study materials for the Christmas tree category for private and commercial pesticide applicators. Private applicators include the traditional farm commodity groups and Christmas tree growers. All applicators who apply pesticides as part of their jobs on land owned by others must have a commercial license.

Study materials include specific commodity manuals such as this manual, fact sheets (if applicable), the manual “How to Comply With the 2015 Revised Worker Protection Standard For Agricultural Pesticides (published in September 2016)” (if applicable), the “National Pesticide Applicator Certification Core Manual (second edition)”, and the New Hampshire Code of Administrative Rules (published in July 2015). To order these study materials, visit the Pesticide Safety Education Program website at <https://extension.unh.edu/Agriculture/Pesticide-Safety-Education-Program>.

This manual is intended to provide information needed to meet the standards of the Environmental Protection Agency (EPA) for pesticide applicator certification. Reading this manual will prepare applicators for the examination given by the State of New Hampshire, Department of Agriculture, Markets and Food. It is not intended to provide all the information needed for effective pest control.

For a more thorough treatment of the topic of identifying and controlling insects and diseases in Christmas trees, readers are referred to the Christmas Tree Pest Manual, third edition published in 2014 by the United State Department of Agriculture (USDA) Forest Service, available at <https://www.na.fs.fed.us/pubs/2014/Christmas-Tree-Pest-Manual-3rd-EditionlowRes.pdf>.



Christmas tree plantation in Plymouth, New Hampshire. Credit: Glove Hollow Christmas Tree Farm.

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I. Causes of Needle Discoloration and Distortion

Balsam Gall Midge (Paradiplosis tumifex)

Hosts: Balsam and Fraser fir.

Symptoms: Larvae of this tiny fly cause small gall formations at the base of new needles. Most infested needles are dropped in the fall, leaving bare branches.

Life Cycle: One generation per year.

- Adults: Emerge in May. Females lay eggs beneath bud scales and on needles of opening buds.
- Larvae: From June to October, larvae form galls on needles, emerge, drop to the ground in the fall, and overwinter in the litter.
- Pupae: Develop the following spring prior to adult emergence.

Control: Spray when terminal buds in the upper third of the tree average 1¼ inch in swollen length. Spray coverage of all buds is necessary. In heavy infestations, two sprays 10 days apart may be necessary. A few yellow sticky boards placed in the tops of trees will capture adults and indicate population levels.



Adult Balsam gall midge (top) and galls on Balsam fir needles (bottom). Credit: Ronald S. Kelley, Vermont Department of Forests, Parks, and Recreation, Bugwood.org.

Drought Injury

Hosts: All species, particularly newly planted trees.

Symptoms: Wilting of new growth, dying needles, and discolored foliage on top branches may appear one or more years after a drought. Needles usually die from the tip. Dead tops, shortened needles, and sparse interior foliage are the result from long-term or repeated droughts.

Control: Avoid planting drought-sensitive species on sandy or gravel soils. Provide supplemental water to new plantings. Control weeds.



Drought damage on Norway spruce. Credit: Petr Kapitola, Central Institute for Supervising and Testing in Agriculture, Bugwood.org.

Herbicide Injury

Hosts: All species.

Symptoms: Abnormal growth such as twisted needles, or hooked, distorted, swollen shoots. Yellowing or browning of new needles may be evident, particularly on the side exposed to the herbicide. Symptoms usually appear within a few weeks after herbicide applications.

Control: Reduce application rates on sites that are prone to flashback injury (herbicide moving from one tree to another via roots). Avoid spraying herbicides to new, succulent shoots. Adjust spray equipment. Use more selective herbicides.



White fir damaged from root translocation of herbicide. Credit: USDA Forest Service - Ogden, USDA Forest Service, Bugwood.org.



Lophodermium Needlecast (Lophodermium spp.)

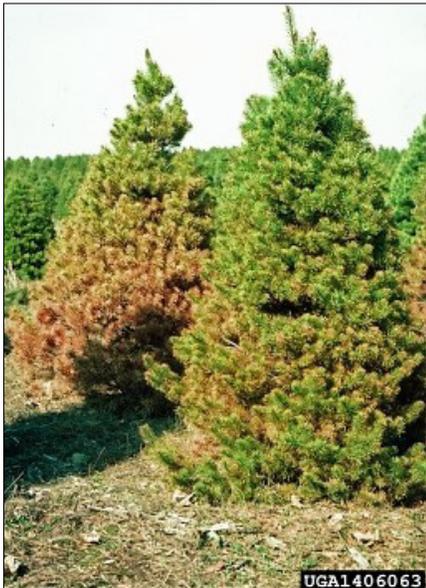
Hosts: Scotch, Austrian, and red pine.

Symptoms: Tiny spots with brown centers and yellow margins appear on needles in early spring, followed by yellowing then browning of needles. Damage is usually more severe at the bottom of the tree. Black, football-shaped, fruiting-bodies appear on dead needles.

Life Cycle:

- Brown spots with yellow margins become evident on needles from March to April.
- Needles turn brown from May to June.
- Needle casting occurs from June to July leaving tufts of green growth on the tips of branches.
- New infections occur during wet periods from August to September.
- Black football-shaped, fruiting-bodies develop on dead needles from July to October.

Control: Plant disease-free stock. Apply a preventive fungicide if the disease has been severe. Spray once every two weeks, beginning at the end of July. If wet weather persists, additional sprays may be needed.



Lophodermium needlecast on Scotch pine. Credits: USDA Forest Service - North Central Research Station, Bugwood.org.

Pine Needle Scale (Chionaspis pinifoliae)

Hosts: All pines.

Symptoms: Small white scales develop on needles which eventually cause yellowing and needle drop. Severe infestations result in branch or tree mortality.

Life Cycle: Two generations per year.

- Nymphs: Crawlers hatch in overwintered eggs in mid-May. They move to new needles to feed and grow.
- Adults: Maturity occurs in early July, new eggs are laid, and a second generation of crawlers hatches by mid- to late July. Eggs are laid and protected by dead female scales.

Control: Remove severely infested trees. Spray thoroughly with a dormant oil in late fall or early spring. If the infestation remains a problem, apply an approved pesticide in mid-May, followed by a second spray 10 days later. Spray again, if needed, in late July or early August. It is best to spray when crawlers are active. Use of sprays other than dormant oils can eliminate natural controls for scale insects, which may compound the problem. Superior or horticultural oils can be used when crawlers are active in June and late July.



Pine needle scales on blue spruce. Credit: William M. Ciesla, Forest Health Management International, Bugwood.org.

Rhabdocline Needlecast (Rhabdocline spp.)

Hosts: Douglas-fir (especially Rocky Mountain variety).

Symptoms: Yellowing on either side of the needle from fall to winter. Spots eventually darken to a reddish brown. Spots enlarge to cause mottling and reddish brown needles which eventually cast. Heavily infested trees are left with only the current needles.

Life Cycle:

- May to July — Needles are infected by spores released in moist weather. Only young needles of opening buds are susceptible.
- Late fall — Yellow spots appear on needles.
- Late fall to spring — Spots turn reddish-brown.
- Early summer — Brown needles are cast.

Control: Avoid using susceptible varieties of Douglas-fir, particularly those from Rocky Mountain seed sources. Plant disease-free stock. Plant Douglas-fir where good air drainage can be assured. Control weeds and remove heavily infected trees. Apply an approved fungicide at bud break. Treatment should be repeated two to three times every two weeks.



Rhabdocline needlecast on Douglas-fir. Credits: Bruce Watt, University of Maine (top), John W. Schwandt, USDA Forest Service (bottom), Bugwood.org.

Spruce Needle Rusts (Chrysomyxa spp.)

Hosts: Black, white, Colorado blue, and occasionally Norway spruces.

Symptoms: Whitish blisters filled with yellow spores on the undersides of current-year needles. In late spring to early summer, needles yellow and shed prematurely.

Life Cycle:

- Spring — Spores from the rust's alternate hosts (Labrador tea or leather leaf) infect nearby spruces.
- Summer — Spores from infected spruces are released, infecting nearby alternate hosts.

Control: Avoid planting susceptible spruces near wet areas where Labrador tea and leather leaf are growing. Plant resistant spruces such as Norway and Black Hills spruces.

Note: Repeating spruce rust, also known as Weir's cushion rust, appears on needles in the spring. This rust does not have an alternate host. Infected trees should be removed.



Spruce needle rusts on blue spruce. Credit: Bruce Watt, University of Maine, Bugwood.org.



Weir's cushion rust on blue spruce. Credit: Bruce Watt, University of Maine, Bugwood.org.



Spruce spider mites and webbing on Norway spruce (top) and white spruce (bottom). Credits: Petr Kapitola, Central Institute for Supervising and Testing in Agriculture (top) and Ward Strong, British Columbia Ministry of Forests (bottom), Bugwood.org.



Swiss needle cast on Douglas-fir. Credits: North Central Research Station (top), Susan K. Hagle (bottom), USDA Forest Service, Bugwood.org.

Spruce Spider Mite (Oligonychus ununguis)

Hosts: All spruces.

Symptoms: Mottled needles with fine webbing between the needles. Needles brown and shed in heavy infestations.

Life Cycle: Three generations per year.

- Nymphs: Hatch in May or June, feed on sap, and spin webs.
- Adults: Appear in June or July. Females lay egg, and two or more generations follow at three-week intervals.

Monitoring: Tap branches over white paper to check mite population density (tiny black specks).

Control: Spider mite injury is most severe during prolonged dry periods on droughty soils or where pesticide use has destroyed natural controls. Monitor mite infestations and spray only if necessary. Use a dormant oil spray in early spring before bud break or thoroughly spray infested trees with an approved miticide in mid-June or early July. Repeat miticide applications at two-week intervals as needed to control succeeding generations. Dormant oils may cause temporary discoloration of blue spruce. Once growth starts, use horticultural or superior oils and not dormant oils.

Swiss Needlecast (Phaeocryptopus gaeumannii)

Host: Douglas-fir.

Symptoms: Yellowing and browning needles. Browning is often uniform at the tip of needles. Symptoms are most severe on lower branches. Symptoms may resemble those caused by environmental stress or nutrient imbalances.

Life Cycle:

- Spring and fall — Rows of black, fruiting-bodies appear on the undersides of green and yellow needles.
- Most infections occur between June and July, but spores may be released from April-September.
- July to August — Two to three years old needles brown and are cast in late August. However, many needles may not be shed until the following year.

Control: Plant disease-free stock. Plant Douglas-fir where good air drainage can be assured. Infected trees should be treated with a fungicide for three years prior to harvest. (Treatment may not be required prior to that time). Apply an approved fungicide when new shoots are ½ to two inches long. Repeat application in two to three weeks and once again if rainfall is abnormally high.

Winter Injury

Hosts: Short-needled Scotch pine varieties, white pine, Norway spruce, white fir, and Fraser fir.

Symptoms: Browning of entire tree or portions that were above the winter snowline. South and southwest sides of trees are usually most susceptible. Injury shows in early spring.

Control: Avoid planting susceptible species in sites that are open and windswept, or provide windbreaks.



Frost and winter injury on Scotch pines. Credit: USDA Forest Service - Northeastern Area, Bugwood.org.



Gypsy moth caterpillar (top) and egg mass (bottom). Credits: Jon Yuschock, Bugwood.org (top) and Dode Gladders, University of New Hampshire Cooperative Extension (bottom).

II. Pests That Feed on Needles

Gypsy Moth (Lymantria dispar)

Hosts: Prefers hardwoods, but will attack Christmas trees.

Symptoms: Partial to complete defoliation of branches or entire trees by groups of hairy caterpillars. Caterpillars can be up to 2 ½ inches long and have black, blue, red, and yellow markings. Tan egg masses are found on tree stems and branches and whitish female moths can be observed.

Life Cycle:

- Larvae: Hatch from overwintered eggs in late April to mid-May. When hardwood foliage is exhausted or moth populations are excessive, any Christmas tree species in the vicinity is vulnerable.
- Pupae: June to July.
- Adults: Emerge in mid-July to early August and begin laying eggs. Females are flightless.

Control: When caterpillars are less than ½ inch long, use biological or hormonal sprays. When the caterpillars are larger, contact or systemic insecticides are most effective.

Sawfly Larvae

Balsam Fir Sawfly (Neodiprion abietis) larvae prefer balsam fir but will also feed on spruces. They have a black head and a dark green body with six black stripes.

European Pine Sawfly (Neodiprion sertifer) larvae were introduced in the U.S. in 1925 and prefer red, Scotch, mugo, Jack, Japanese, and Swiss mountain pines. They have a black head and legs and a greyish green body with lighter stripes and black dots.

Introduced Pine Sawfly (Diprion similis) larvae were introduced in the U.S. in 1914 and prefer white pine, but will also feed on Scotch, red, Jack, and mugo pines. They have a black head and a black body with yellow and white spots.

Redheaded Pine Sawfly (Neodiprion lecontei) larvae prefer two or three needled pines (red, Scotch, mugo, Jack, pitch), but may attack white pines as well. They have a red head and a yellowish-white body with rows of black spots.

Yellowheaded Spruce Sawfly (Pikonema alaskensis) larvae feed on all spruces. They have a brown or reddish-yellow head with a light green body and two green stripes.

Life Cycle: These hairless caterpillar-like larvae appear any time from early May to late July. They are voracious eaters of needles and often found in groups. Some will raise up in a defensive posture when threatened.

Control: These are easily controlled by one application of a contact insecticide when the larvae are first noticed feeding.



Introduced (top) and red-headed pine sawfly larvae (bottom). Credits: Dode Gladders, University of New Hampshire Cooperative Extension.

Spruce Budworm (Choristoneura fumiferana)

Hosts: All spruces, firs, and occasionally pines.

Symptoms: Defoliated shoot-tips or branches. Clusters of brownish needles attached to the twigs with silk-webbing. One-inch caterpillars with black heads, light-brown bodies when small, or gray-brown with small cream-colored spots along the sides when mature.

Life Cycle:

- Larvae: Emerge from eggs found on needles in late July or early August. Larvae move to branch-tips, dangle from silken threads, and are blown to new host trees in which they spin hibernacula and overwinter. Larvae emerge the next spring, go to branch-tips, and get blown to new host foliage. Feeding begins on open buds and needles in mid-May.
- Pupae: Occur in feeding shelters or protected locations on host trees in late June to early July.
- Adults: Emerge late June through early August.

Control: Consider spraying when larvae are found at the frequency of one or two per 10 spruce buds or one or two per 20 fir buds. Spray thoroughly with an approved pesticide after larvae emerge in May. Repeat spray in seven to 10 days if needed. Only a problem in Coös county.



Spruce budworm symptoms (top) and larvae (bottom). Credits: Joseph OBrien (top) and Northeastern Area (bottom), USDA Forest Service, Bugwood.org.



Spruce needle miner larva (top) and webbed dead needles on a white spruce branch (bottom). Credit: Connecticut Agricultural Experiment Station (top) and Steven Katovich, USDA Forest Service (bottom), Bugwood.org.

Spruce Needle Miner (Endothenia albolineana, Coleotechnites piceaella)

Hosts: All spruces.

Symptoms: Small clusters of dead needles webbed tightly together and flattened against the branch. Needles are hollowed out with a tiny hole near their base. Small trees are often attacked anywhere while large trees are usually injured on the inner parts of lower branches.

Life Cycle: One generation per year.

- Larvae: Hatch from eggs laid on needles in mid-June. Needles are mined out, cut, and webbed together for protection as the larvae develop. Larvae overwinter in these nest-like enclosures, feed again in early spring, and pupate.
- Pupae: Pupation occurs in silken cocoons in nests in late April.
- Adults: Mid-May to mid-June.

Control: Spray with an approved pesticide in mid- to late June. Repeat the spray in 10 to 14 days.



Pine Webworm (Pococera robustella)

Hosts: All pines.

Symptoms: Nests are made of brownish needles and pellets of insect waste spun together with webbing. Nests are two to six inches wide and needles near them are chewed off. Yellowish brown caterpillars about $\frac{3}{4}$ inch long with two dark brown stripes on either side can be found in nests.

Life Cycle:

- Larvae: Emerge from eggs laid on needles from July to August. Young larvae mine needles. Older ones inhabit protective nests.
- Pupae: Occur in a cell in the soil in August.
- Adults: Emerge from overwintering pupal cells from June to August.

Control: Clip and destroy nests if they are few and scattered. If necessary, spray with an approved pesticide when webbing is noticed (usually between July and August).

Pine webworm larva (top) and nest (bottom). Credits: Connecticut Agricultural Experiment Station, Bugwood.org.

III. Causes of Shoot or Branch Injury

Pine Bark Adelgid (Pineus strobi)

Hosts: White pine and occasionally Scotch pine.

Symptoms: White woolly patches on trunks, branches, buds, and needle bases. Discolored sparse foliage. Scattered needles turn yellow or brown in summer and drop off in fall. Needles turn brown from the tips down. Look for ant activity on the foliage.

Life Cycle: Five generations per year.

- Eggs: Overwintering females lay eggs in spring.
- Adults: Winged and wingless females hatch. Wingless forms remain on host and reproduce repeatedly. Winged forms fly to nearby spruce and lay eggs.

Control: Avoid overspraying for aphid control, since it may kill natural aphid predators. Remove nearby mound ant colonies, which can help promote aphid outbreaks. If necessary, spray with an approved pesticide in May and early June. Three applications at 10-day intervals are necessary.

Pine Leaf Adelgid (Pineus pinifoliae)

Hosts: White pine, red and black spruces.

Symptoms:

- White pine — Brown to yellow needles die from the tip down. Drooping shoots, reduced growth or death may occur.
- Spruces — Compact terminal galls which resemble tree cones.

Life Cycle:

- Adults: Scale-like with a fringe of white hairs.
- Life cycle takes two years to complete. In the first winter, spruces are infested. During the remaining stages, including the second winter, nearby white pines are attacked.

Control: Occasional outbreaks of this pest may require spray control measures. Avoid overspraying for aphid control. This may kill natural aphid predators. If necessary, spray with an approved pesticide. Treat pine foliage in late June and repeat in 10 days.



Pine bark adelgid infestation on eastern white pine. Credits: Petr Kapitola, Central Institute for Supervising and Testing in Agriculture, (top) and Steven Katovich, USDA Forest Service (bottom), Bugwood.org.



Pine leaf adelgid: females (top) and damage (bottom). Credits: Ronald S. Kelley, Vermont Department of Forests, Parks and Recreation (top) and Whitney Cranshaw, Colorado State University (bottom), Bugwood.org.



White pine aphids on Eastern white pine. Credit: Steven Katovich, USDA Forest Service, Bugwood.org.

White Pine Aphid (Cinara strobi)

Hosts: White pine.

Symptoms: Reduced tree vigor, dead individual branches, or death of small trees. Dark brown shiny adult aphids clustered around a branch or leader. A black mold will grow on aphid excrement and cover needles and bark.

Life Cycle: Several generations per year.

- Spring: Wingless females hatch from overwintering eggs in the spring. These females produce several generations of living young.
- Mid- to late summer: Winged females hatch, migrate, and begin producing living young. Toward fall, winged males and females mate and overwintering eggs are laid.

Control: Avoid overspraying for aphid control. This may kill natural aphid predators. Remove nearby ant colonies, which can help promote aphid outbreaks. If necessary, spray with an approved pesticide in early May and repeat in 10 days.



Cytospora canker. Credit: Joseph OBrien, USDA Forest Service, Bugwood.org.

Cytospora Canker (Also Called Leucostoma Canker; Cytospora kunzei)

Hosts: Spruces, especially Colorado blue and Norway (true firs and Douglas-fir are occasionally infected).

Symptoms: Death of branch-tips and entire branches on the lower portions of infected trees. Infection usually spreads upwards from lower branches. White pitch oozes from canker sites. Cankers are difficult to spot in the absence of pitch.

Life Cycle: Orange masses of spores ooze from tiny black fruiting-bodies around the cankers during wet weather. Rain and improperly disinfected tools can spread spores to stressed trees where infection occurs through wounds or dead areas.

Control: Keep host species well-maintained to avoid stress. Avoid planting susceptible species on poor sites. Shear only when branches are dry. Remove and destroy affected branches. Sterilize tools after pruning infected branches.



Diplodia shoot blight. Credit: Elizabeth Bush, Virginia Polytechnic Institute and State University, Bugwood.org.

Diplodia Shoot Blight (Also Called Sphaeropsis; Diplodia spp.)

Hosts: Scotch, red, Japanese black, and Austrian pine.

Symptoms: Stunted, curled or dead current-year shoots on many branches. The infected tissue is resin-soaked. The surrounding bark turns deep red. Tissue beneath the bark is often streaked black or olive-green. Cankers appear as oblong sunken areas on branches or stems. The top of the tree above girdling cankers will die. Black beak-like fruiting-bodies are visible on dead needles or shoot-tissues.

Life Cycle: From spring through fall, growing shoots on stressed trees are infected by spores released during wet weather from overwintering fruiting-bodies. Infection often corresponds with wounds such as those caused by shearing or spittlebug feeding. The fungus enters host species through open wounds on shoots such as hail-wounds and sites of insect-feeding.

Control: Keep host species well maintained. Avoid planting susceptible species on poor sites. Shear only when branches are dry. Remove and destroy affected branches. Sterilize tools after pruning affected branches. Destroy severely infected trees. Treat with an approved fungicide when new growth begins. Make additional applications at two-week intervals. Four applications may be necessary in rainy springs.

Eastern Pine Shoot Borer (Eucosma gloriola)

Hosts: All pines, white spruce, and Douglas-fir.

Symptoms: Flagged (discolored and drooping) shoots. Branch-ends broken-over near the bases, leaving flat stubs. Oval-shaped holes at the base of injury. Hollowed out twigs with white gray $\frac{3}{4}$ inch long larva (before mid-July).

Life Cycle:

- Adult: Emerge from overwintering pupae in May.
- Larvae: Hatch from eggs laid on needle-sheaths of new shoots or lateral branches in June. Larvae bore into the pith and tunnel toward branch-tips.
- Pupae: Pupation occurs from late July to early August.

Control: Prune out and destroy infested shoots while larvae are still active (June to July). If necessary, spray with an approved insecticide in mid-May to kill larvae before they bore into shoots.

European Pine Shoot Moth (Rhyacionia buoliana)

Hosts: Scotch, red, and Austrian pine.

Symptoms: Dead, stunted, or stubby shoots anywhere on the tree. Hardened globs of pitch where larvae have bored into the shoots. Brownish, black-headed larvae $\frac{5}{8}$ inch-long on, or inside, new shoots (mid-April to early June). Repeatedly attacked trees look bushy and multi-headed.

Life Cycle: One generation per year.

- Adults: June.
- Larvae: Hatch from eggs laid on the bases of buds and needle fascicles (needle-bundles), twig tips, or bark of shoots in late June. Larvae



Diplodia shoot blight. Credit: Susan K. Hagle, USDA Forest Service, Bugwood.org.



Eastern pine shoot borer damage (deformed stem). Credit: Minnesota Department of Natural Resources, Bugwood.org.



European pine shoot moth larva. Credit: Mariusz Sobieski, Bugwood.org.



Adult European pine shoot moth. Credit: Cheryl Moorehead, Bugwood.org.



Frost injury of Douglas-fir. Credit: Dave Powell, USDA Forest Service (retired), Bugwood.org.



Northern Pine Weevil. Credits: Alan T. Eaton, University of New Hampshire Cooperative Extension.



Adult pales weevil. Credit: Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org.

spin resin-coated webs and mine the bases of needles. In mid-summer, larvae move to buds and construct new resin-coated webs. Overwintering larvae resume feeding the following April.

- Pupae: May to June.

Control: Prune out and destroy infested shoots while larvae are still active. Remove bottom whorls of branches to prevent overwintering below the snowline. Spray with an approved insecticide in the first two weeks of April and/or late June or early July.

Frost Injury

Hosts: True firs (balsam fir, Fraser fir), Douglas-fir, spruce, and occasionally pine.

Symptoms: Current year's shoots appear brown, wilted, and eventually die. Nearly all shoots on a tree may be affected. Shoots often remain on trees until the following spring. Symptoms are more common on trees in low areas and frost pockets.

Control: Avoid planting susceptible species in frost pockets. Remove dead shoots when shearing.

Northern Pine Weevil (*Pissodes approximatus*)

Hosts: All pines and spruces.

Symptoms: Flagged shoot-tips anywhere on trees. Small circular feeding-wounds at the base of injured shoots.

Life Cycle: One generation per year (overwinter as adults, larvae, or pupae).

- Adults: Feed on inner bark of pine branches in June and August.
- Larvae: Hatch from eggs laid in the roots of pine stumps, slash, logs, weakened trees, and occasionally healthy young trees. Larvae are white, C-shaped, and 1/3 inch in length. They feed beneath the bark until fall, form cells of sawdust in the sapwood and pupate.
- Pupae: Pupation occurs in August.

Control: Remove pine slash, dead, or dying pines and fresh stumps if possible or drench fresh stumps and surrounding soil with an approved pesticide in April and again in August. Spray trees in August or early September with an approved pesticide.

Pales Weevil (*Hylobius pales*)

Hosts: White and Scotch pine, Douglas-fir and, occasionally, spruces.

Symptoms: Dead seedlings. Dead shoot-tips anywhere on large trees. Small irregular patches of exposed wood on the stems of seedling or the bases of trees. Flagged shoots on large trees.

Life Cycle: One generation per year (overwinter as adults or larvae).

- Adults: Mid-April to September — Feed on bark, twigs, and needles in fall. Overwintering adults feed on the tender bark of the twigs of saplings and at the bases of seedlings.
- Larvae: April to June — Hatch from eggs laid in the roots of pine stumps or weakened trees. Larvae are white, C-shaped, ½ inch-long. They feed beneath the bark until early fall and either form cells and pupate or overwinter as larvae and pupate the following spring.
- Pupae: Pupation occurs in August or late May.

Control: Remove pine slash, dead, or dying pines and fresh stumps if possible, or drench fresh stumps and surrounding soil with an approved pesticide in April and again in August. Spray trees in mid-to late April and again in August. Seedlings can be protected during their first year by dipping them in an approved pesticide prior to planting.

Pine Spittlebug (Aphrophora parallela)

Host: Scotch and white pine, all spruces and firs.

Symptoms: Flagged shoot-tips anywhere on trees. Sooty and glistening foliage. Frothy, white spittlemasses in May through early July with ¼ inch-long creamy yellow to black nymphs within.

- Life Cycle: One generation per year.
- Adults: Feed without producing spittlemass from July to August.
- Nymphs: May to July — Hatch from overwintering eggs. Feed on twigs and eventually move to the main trunk where several occupy one spittlemass.

Control: Often not necessary. Damage is most severe on young trees. Spittlebugs can help spread *Diplodia* shoot blight. If necessary, spray in early to mid-July with an approved pesticide.

Saratoga Spittlebug (Aphrophora saratogensis)

Hosts: Scotch pine and occasionally white pine, Fraser fir, and balsam fir.

Alternate Hosts: Sweetfern, brambles, and broad-leaved weeds.

Symptoms: Reddish-brown flagged branches with numerous punctures covered with small drops of resin and tan flecks in the wood and inner bark. Alternate hosts in mid-May to early June



Pales weevil: damage. Credit: Eric R. Day, Virginia Polytechnic Institute and State University, Bugwood.org.



Pine spittlebug nymphs in their spittlemass. Credit: Dode Gladders, University of New Hampshire Cooperative Extension.



Adult Saratoga spittlebug. Credit: Darren Blackford, USDA Forest Service, Bugwood.org.



Damage to red pine caused by Saratoga spittlebug. Note: the pine is growing in a dense stand of sweetfern. Credit: Steven Katovich, USDA Forest Service, Bugwood.org.

have frothy spittlemass with 1/3 inch-long tan and white boat-shaped nymphs within. Spittlemasses are near ground level.

Life Cycle:

- Adults: Feed mostly on two-year-old internodes by inserting mouthparts into the cortex of the shoots from late June to late September.
- Nymphs: Hatch in May from overwintered eggs laid on pines. Nymphs crawl to nearby alternate hosts and feed through July.

Control: Often not necessary. Well-maintained plantations with good weed control are usually protected. If necessary, spray in early to mid-July with an approved pesticide.



Damage from *Scleroderris* spp. canker. Credit: USDA Forest Service - Region 2 - Rocky Mountain Region, Bugwood.org.

***Scleroderris* Canker (*Scleroderris* spp.)**

Hosts: All pines, occasionally spruces, firs, and Douglas-fir.

Symptoms: Cankers are oblong sunken areas on stem and branches with (often inconspicuous) green discoloration beneath the bark of dead branches. From May through June, an orange discoloration is usually visible at the bases of needles on the lower four feet of trees.

Life Cycle:

- April to October: Infection occurs through buds or needles by spores during moist weather.
- Late summer to November: Branch-tips die. The fungus grows down the branch and forms a canker on the main stem. Small trees are often killed. Spores are splashed from one- to two-year-old infections on dead branches or from culled trees.

Control: This is believed to be a potentially serious pathogen introduced from Europe. It is not well established in New Hampshire, so if found, quickly remove and destroy infected branches. Dead trees should be removed. All infected trees should be burned or buried. Sterilize tools after shearing infested trees to avoid spreading the disease. Do not shear during wet weather. Plant disease-free stock.



White pine blister rust. Credit: USDA Forest Service, Bugwood.org.

White Pine Blister Rust (*Cronartium ribicola*)

Host: White pine.

Alternate Host: Currant and gooseberry.

Symptoms: On young twigs look for patches of brown bark with yellow-green borders. On the branches or the trunk, spindle-shaped swellings appear in the third year, or resin flow and possible insect or rodent feeding may be evident on mature yellow-bordered cankers. Branches

and tree trunks above stem cankers eventually die leaving dry, reddish-brown needles. Cream-colored blisters become visible pushing through infected bark in May.

Life Cycle:

- Spring: Orange aeciospores are released from white blisters on pine and infect gooseberry.
- Summer: Spores released from minute brown hair-like fungal structures on the underside of gooseberry leaves infect needles of white pine. The fungus moves down the needle into a branch or the main stem and produces the aeciospores two to three years later.

Control: Remove currant and gooseberry bushes within 1,000 feet of the plantation. The disease only occurs on white pine, so plant alternative species in areas where the disease is severe. Avoid planting in low, air-drainage areas. Prune and destroy infected branches before infections reach the main stem.

White Pine Weevil (Pissodes strobi)

Hosts: All species, especially white pine, Norway spruce, Colorado blue spruce, and Douglas-fir.

Symptoms: Dead or dying terminal leader. Leader curls into the shape of a shepherd's crook. White larvae up to ¼ inch-long in the wood of the damaged terminal in June to August. Small brown beetles feeding on the leaders in April and May and again in August and September.

Life Cycle:

- Adults: Emerge in late July and feed on the bark of terminal leaders, drop to the litter, and overwinter. In mid-April to May they return to the terminal leaders to lay eggs under the bark.
- Larvae: Hatch and bore down through the terminal leaders and one or two whorls of branches.
- Pupae: Pupation occurs in wood chip cocoons at the base of larval feeding.

Control: Clip and destroy infested leaders while larvae are still active (June to mid-July). Drench leaders with an approved pesticide in mid-April in southern New Hampshire and early May in northern New Hampshire to control adult egg-laying beetles. A second spray between mid-August and September may be necessary if egg laying occurs over a long period.



White pine blister rust. Credit: Steven Katovich, USDA Forest Service, Bugwood.org.



Adult white pine weevil. Credits: Darren Blackford, USDA Forest Service, Bugwood.org.



Cooley spruce gall adelgid: egg cluster (top) and late stage nymphs within gall chamber (bottom). Credits: Robert Childs, UMass Extension (top) and Whitney Cranshaw, Colorado State University, Bugwood.org (bottom).

IV. Pests That Cause Shoot or Branch Galls

Cooley Spruce Gall Adelgid (Adelges cooleyi)

Hosts: Colorado blue spruce, Douglas-fir and, occasionally, other spruces.

Symptoms:

- On spruce — Large two to 2 ½ inch-long cone-like galls on the tips of new shoots. Galls are green at first and brown with age.
- On Douglas-fir — Yellow spots on bent needles and small cottony galls on the undersides of needles.

Life Cycle: One generation per year.

- Eggs: Laid in the spring under a layer of white, cottony wax near terminal buds.
- Nymphs: Hatch and feed at the base of needles, producing galls that protect them. Galls dry mid-summer exposing nymphs which either continue to feed on blue spruce or fly to Douglas-fir. Galls do not form on Douglas-fir. Overwinter as nymphs.

Control: Avoid mixing Douglas-fir and Colorado blue spruce in the same plantation. Clip and destroy scattered galls before they open in July. Apply a dormant oil in early spring or late fall when trees are dormant OR apply a horticultural oil (superior oil) in late summer or fall after the galls have opened. Oil may cause a temporary discoloration of blue spruce.

Eastern Spruce Gall Adelgid (Adelges abietis)

Hosts: Norway, red, white, and black spruces.

Symptoms: Small, pineapple-shaped, ¾ to one inch-long galls at the bases of new shoots. Galls are green at first and brown with age.

Life Cycle: One generation per year.

- Eggs: Laid by overwintering immature nymphs at the bases of buds. Hatching occurs when buds begin to break.
- Adults: Nymphs feed on needle bases which swell and form protective galls. Galls dry in late September and aphids lay eggs which hatch to produce overwintering nymphs.



Damage from Eastern spruce gall adelgid. Credit: E. Bradford Walker, Vermont Department of Forests, Parks, and Recreation, Bugwood.org.

Control: Clip and destroy scattered galls before they open. Apply a dormant oil in early spring or late fall when trees are dormant OR apply an approved pesticide in late April or early May and again in the fall after the galls have opened.

V. Pests That Cause Stem, Branch or Root Injury Resulting in Tree Mortality

Allegheny Mound Ant (Formica exsectoides)

Hosts: All species.

Symptoms: Groups of dead or dying trees. Bases of trunks have small blister-like swellings. Large nearby ant mounds, one to three feet high. Large ants (¼ inch-long) with red abdomen tips.

Biology: Ants kill trees that shade mounds by injecting formic acid into the tissue of the main stem just above ground level. Ants also protect aphids and scales on live trees by discouraging their natural predators and parasites.

Control: Treat mounds with an approved pesticide. Level the mound with a rake and time pesticide application to precede a heavy rain, if possible.

Armillaria Root Rot (Armillaria spp.)

Hosts: All species.

Symptoms: Dead and dying trees, singly or in groups. Oozing pitch from the root collar. Creamy-white tissue-like sheets or fans of fungal strands under the bark at the root collar.

Life Cycle: In fall, honey-colored mushrooms develop on stumps or dead and dying trees. Spores from the mushrooms are carried by wind to other stumps or dead trees and to the wounds near the base of healthy trees. The fungus develops rhizomorphs from infected sites. The rhizomorphs are tough fungal strands with a dark outer layer. These cord-like strands can extend for many feet and infect roots of healthy trees.

Control: Avoid planting on cutover sites if possible, especially hardwood sites. Keep plantation site properly limed and fertilized to maintain vigorous trees. If planting on cutover sites, prepare sites by stumping and root raking before planting. Avoid planting next to stumps. Avoid drought-prone planting sites.

Meadow Voles (Microtus pennsylvanicus)

Hosts: All species.

Symptoms: Dead or dying trees, singly or in groups. Girdled trunk low on the stem.

Biology: Meadow voles feed on tree bark in winter months when other vegetation is not available. Damage is highest when vole populations are high, snow is deep, and/or dense matted vegetation is around tree trunks.

Control: Late fall mowings and good herbicide programs help discourage vole population build-ups.



Mound from Allegheny mound ant.
Credit: Steven Katovich, USDA Forest Service, Bugwood.org.



White mats of *Armillaria* spp. under the bark of a white spruce. Credit: Joseph OBrien, USDA Forest Service, Bugwood.org



Meadow vole. Credit: L.L. Master, Mammal Images Library of the American Society of Mammalogists.



Pine Root Collar Weevil (Hylobius radialis)

Hosts: Scotch and occasionally white pine.

Symptoms: Dead or dying trees, singly or in groups. Leaning or fallen trees. Black, pitch soaked bark at the root collar. Surrounding soil is often pitch soaked. Yellow-white, C-shaped, legless larvae up to 1/3 inch-long with brown heads in the bark or adjacent soil.



Life Cycle: One generation per year.

- Eggs: Laid at the bases of pines by overwintered adults in spring and summer.
- Larvae: Feed on the inner bark of the root collar.
- Pupae: Develop in soil near infested trees.
- Adults: Emerge in late summer, feed on trees, and overwinter in the litter.

Control: Plant resistant Scotch pine varieties (S. French, Turkish, generally short-needled varieties). Prune off lower branches. Treat infested plantations with an approved pesticide. Spray the soil and bark at the base of the trees in mid-June and repeat in 10 days. Avoid replanting infested sites for one year.

Pine root collar weevil: adult (top) and damage (bottom). Credits: Jennifer C. Giron Duque, University of Puerto Rico (top) and Steven Katovich, USDA Forest Service (bottom), Bugwood.org.

White Grubs (Multiple Species)

Hosts: All species.

Symptoms: Dead or dying trees, singly or in groups. Leaning or fallen trees. Dead or fallen trees have few fibrous roots. White C-shaped grubs up to one inch long with brownish heads in the upper six inches of soil from May to September. Large dead patches of grass or loose turf.

Life Cycle:

- Eggs: Laid in soil by adult June beetles in June or July.
- Larvae: Burrow into the soil and feed on the roots of grass or woody plants. Larvae feed for two to five years before becoming adults.
- Adults: Emerge in May or June and feed on hardwood trees near the plantation.

Control: Inspect fields carefully before planting. Use herbicides to control grasses around trees and before planting. Plant seedlings carefully to avoid J-rooting, as these are attacked first. Apply an approved pesticide on the field from May to August. Treat entire field or planted rows. Time the applications to precede a heavy rain, if possible.



Evidence of white grub activity. Credit: M.G. Klein, USDA Agricultural Research Service, Bugwood.org.

Zimmerman Pine Moth (Dioryctria zimmermani)

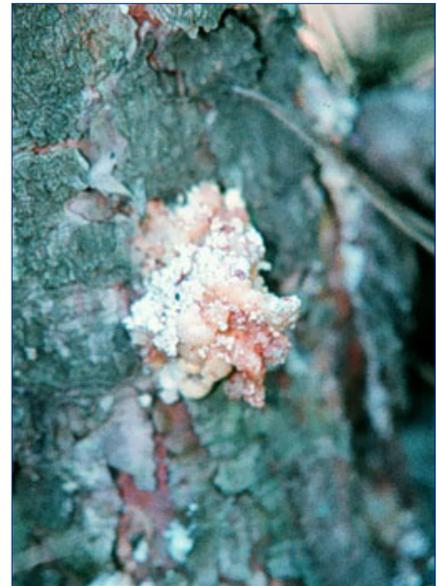
Hosts: Scotch and Austrian pines and occasionally other pines.

Symptoms: Dead branch-tips on entire trees. Pitch-masses at branch whorls, on main stems or near terminal leaders. Occasional broken branch-tips or stems at or near pitch-mass sites. Whitish or reddish-yellow or green larvae with a series of black dots each with a bristle in mid-May to August.

Life Cycle: One generation per year.

- Eggs: Laid on bark from mid-July to mid-August.
- Larvae: Spin silken cases and overwinter in bark crevices. From early April to early May, emerging larvae bore into shoots or stems and form characteristic pitch masses at the entrance of their feeding tunnels.
- Pupae: Develop in feeding tunnels in May.

Control: Destroy infested branches or trees. Plant resistant Scotch pine varieties (Greek, Turkish, generally short-needled varieties). Apply an approved pesticide to the bark and twigs in late April or early May. Further applications may be necessary from late June to early August.



Zimmerman pine moth: pitch mass on trunk (top) and pupa within feeding tunnel (bottom). Credits: Rayanne Lehman, Pennsylvania Department of Agriculture (top) and Phil Pellitteri, University of Wisconsin - Entomology Department (bottom), Bugwood.org.

VI. Helpful Resources

Refer to the “*New England Guide to Chemical Weed and Brush Control in Christmas Trees*” for information about herbicide use in Christmas tree plantations:

- https://extension.unh.edu/resources/files/Resource000845_Rep2560.pdf.

To find the location of the *UNH Cooperative Extension office* in your county:

- Visit: <https://extension.unh.edu/County-Office-Locations>.
- Or contact our Education Center & Information Line by phone at 1-877-EXT-GROW (1-877-398-4769), in person (9 a.m. to 2 p.m., Monday through Friday) or by email, answers@unh.edu.

For general information on how to grow Christmas trees, refer to the fact sheet “*Establishing the Christmas Tree Plantation*”:

- https://extension.unh.edu/resources/files/Resource000982_Rep1108.pdf.

For *diagnostic and testing services*:

- Samples may be taken to UNH or mailed. A fee is charged and an application form is required for all samples.
- For soil testing service, contact the Soil Testing Laboratory: <https://extension.unh.edu/Problem-Diagnosis-and-Testing-Services/Soil-Testing>.
- For insect (and other arthropod) identification, fill out a form with the Arthropod Identification Center at: <https://extension.unh.edu/Problem-Diagnosis-and-Testing-Services/Insect-Identification-Service>.
- For disease identification, contact the Plant Diagnostic Laboratory: <https://extension.unh.edu/Problem-Diagnosis-and-Testing-Services/Plant-Diagnostic-Lab-Plant-Health-Program>.



Christmas tree plantation in Farmington, New Hampshire. Credit: Conley Tree Farm.

Stop! Read the label on every pesticide container each time before using the material. Pesticides must be applied only as directed on the label to be in compliance with the law. Contact the Division of Pesticide Control at (603) 271-3550 to check registration status. Dispose of empty containers safely, according to New Hampshire regulations.

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