# Integrated Pest Management Field Guide For Christmas Trees: Douglas Fir, True Firs, Spruce

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Integrated Pest Management

Cornell University Cooperative Extension Dutchess County

# Insects/Diseases by Tree Species

**True Firs: (Fraser, Canaan, White, Balsam, etc.)**

**Spruce spider mite, Cooley spruce gall adelgid, balsam twig aphid, balsam gall midge, spider mites, white pine weevil, elongate hemlock scale**

**Phytophthora root rot, Needle rust (Uredinopsis sp.), Canker**

**Douglas Fir:**

**Cooley spruce gall adelgid, Douglas fir needle midge, eastern spruce gall adelgid, white pine weevil, pine needle scale, pales weevil, elongate hemlock scale, spider mites**

**Rhabdocline needlecast, Swiss needlecast, Armillaria root rot**

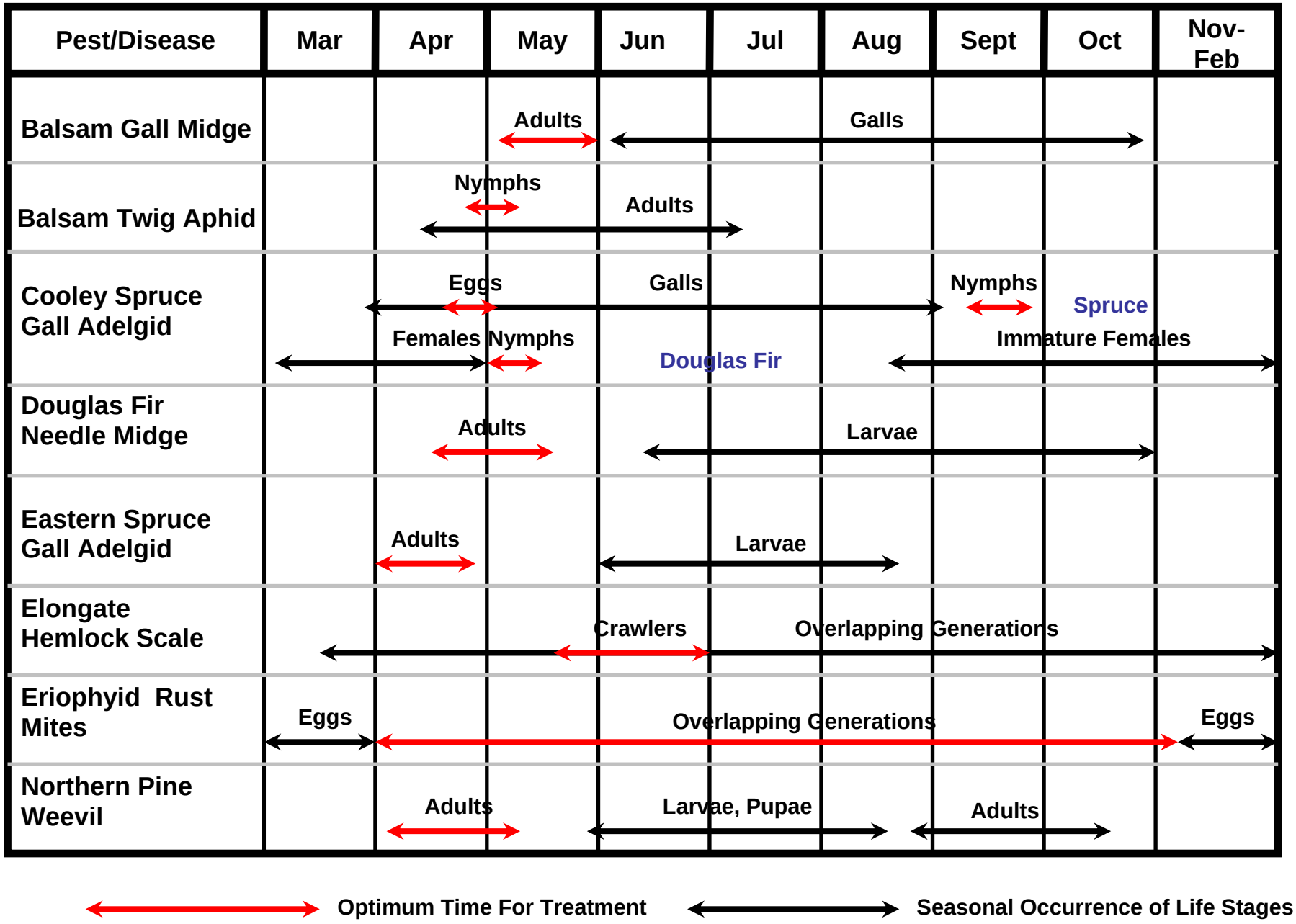
**Spruces:**

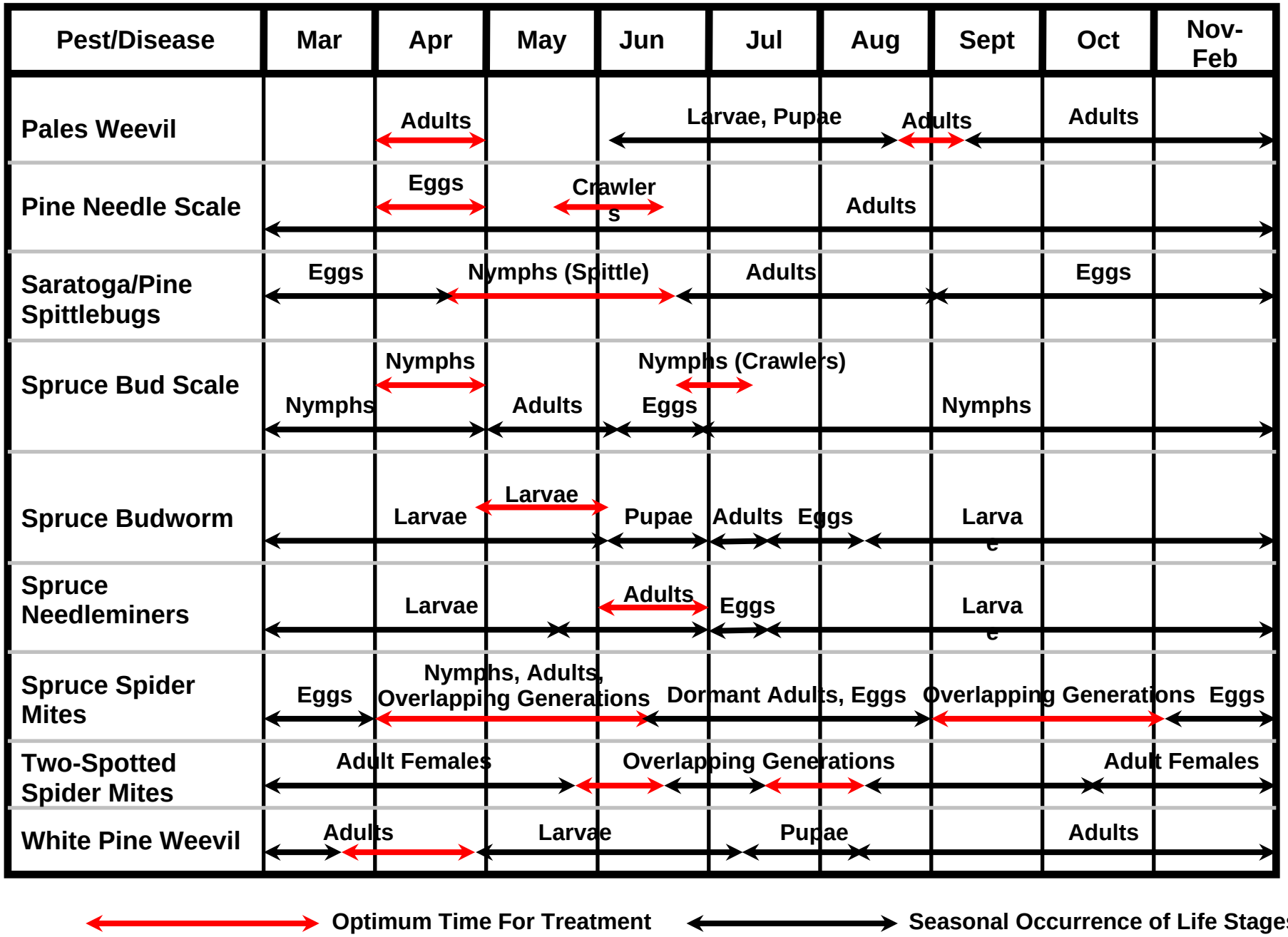
**Cooley spruce gall adelgid, eastern spruce gall adelgid, northern pine weevil, Pales weevil, pine needle scale, spruce bud scale, spruce budworm, spruce needleminers, spruce spider mites, white pine weevil, elongate hemlock scale, spider mites**

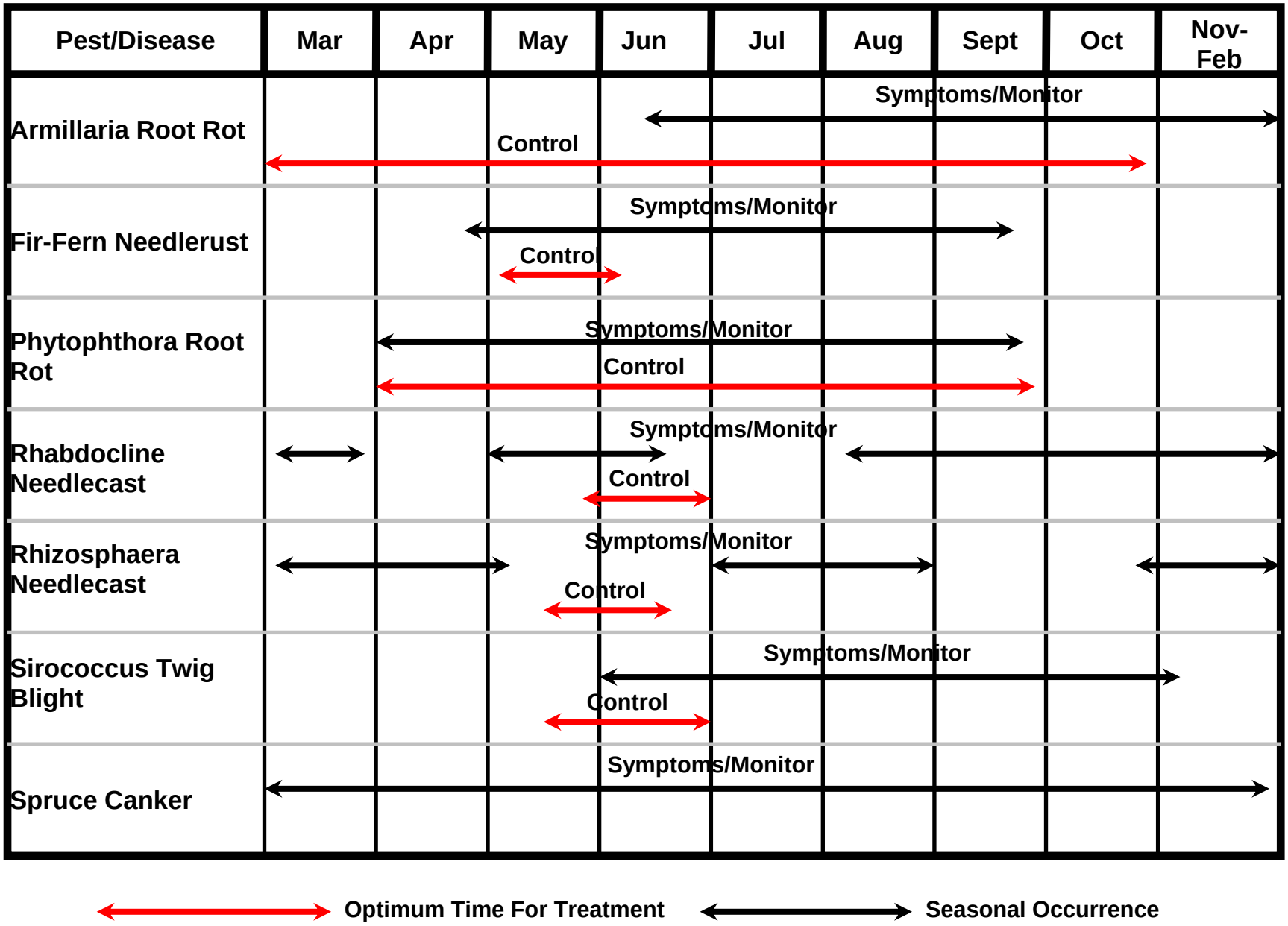
**Armillaria root rot, Leucostoma canker, Rhizosphaera needlecast, Sirococcus twig blight, Weir's cushion rust**

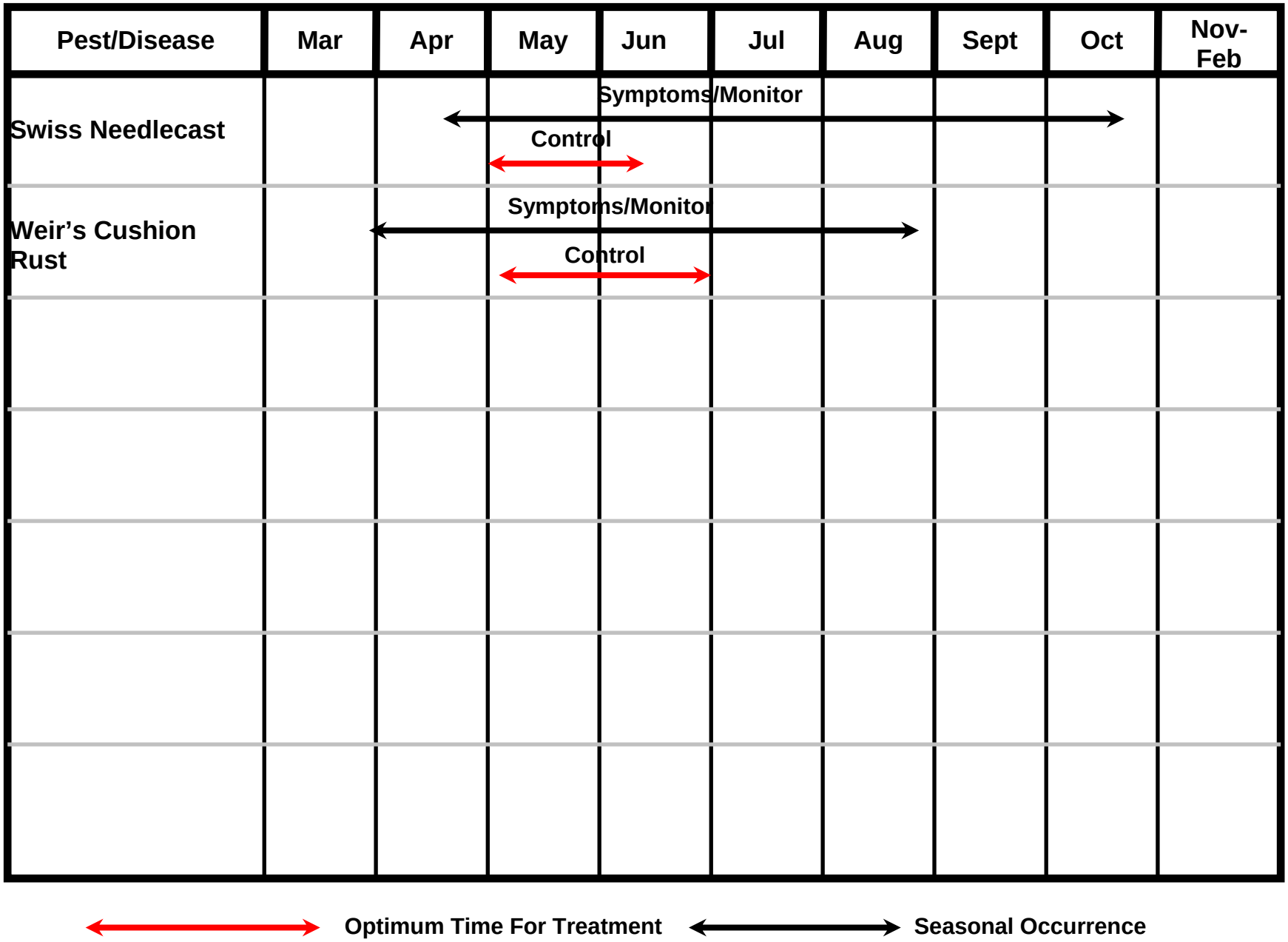
# Index of Growing Degree Days (GDD) Calendar

| Pest | GDD | Plant Phenology (Time of Bloom) |
|---|---|---|
| Balsam Gall Midge | 120-299 | Japanese quince |
| | | Saucer magnolia |
| Balsam Twig Aphid | 30-100 | Boxelder, Star magnolia |
| Cooley Spruce Gall Adelgid | | |
| Spruce | 22-81 | Japanese quince |
| | 1850-1950 | Hydrangea paniculata |
| Douglas fir | 120-190 | |
| | 1500-1775 | |
| Douglas Fir Needle Midge | GDD N/A | Early May |
| Eastern Spruce Gall Adelgid | 22-170 | Boxelder, periwinkle |
| Elongate Hemlock Scale | 7-120 | Tartarian honeysuckle, |
| | 360-700 | Beautybush |
| Eriophyid Mites | | |
| Hemlock Rust Mite | 7-450 | |
| Rust Mites | 533-802 | Mountain laurel |
| | 1644-2033 | Butterfly bush |
| Northern Pine Weevil | 7-192 | Pussy willow, Boxelder |
| Pales Weevil | 7-121 | Silver maple, Star magnolia |
| Pine Needle Scale | 298-448 | Pussy willow, Redbud |
| Saratoga Spittlebug | 148-298 | Japanese quince, Redbud |
| Pine Spittlebug | | |
| Spruce Bud Scale | 22-121 | Star magnolia |
| | 912-1388 | Rhododendron maximum |
| Spruce Budworm | GDD not available | Late April Through mid-June |
| Spruce Needleminers | 448-802 | Mountain laurel, Mock orange |
| Spruce Spider Mites | 7-121 | Pussy willow |
| | 192-363 | Redbud |
| | 2375-2806 | Witch hazel |
| Two-Spotted Spider Mites | 363-318 | Tartarian honeysuckle |
| | 1300-2000 | Butterfly bush |
| White Pine Weevil | 7-58 | Silver maple |


Pest/Disease
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov-Feb
Balsam Gall Midge
Adults
Galls
Balsam Twig Aphid
Nymphs
Adults
Cooley Spruce Gall Adelgid
Eggs
Galls
Nymphs
Spruce
Females
Nymphs
Douglas Fir
Immature Females
Douglas Fir Needle Midge
Adults
Larvae
Eastern Spruce Gall Adelgid
Adults
Larvae
Elongate Hemlock Scale
Crawlers
Overlapping Generations
Eriophyid Rust Mites
Eggs
Overlapping Generations
Eggs
Northern Pine Weevil
Adults
Larvae, Pupae
Adults
Optimum Time For Treatment
Seasonal Occurrence of Life Stages


Pest/Disease
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov-Feb
Pales Weevil
Adults
Larvae, Pupae
Adults
Adults
Pine Needle Scale
Eggs
Crawlers
Adults
Saratoga/Pine Spittlebugs
Eggs
Nymphs (Spittle)
Adults
Eggs
Spruce Bud Scale
Nymphs
Nymphs (Crawlers)
Nymphs
Adults
Eggs
Nymphs
Spruce Budworm
Larvae
Larvae
Pupae
Adults
Eggs
Larvae
Spruce Needleminers
Adults
Larvae
Eggs
Larvae
Spruce Spider Mites
Eggs
Nymphs, Adults, Overlapping Generations
Dormant Adults, Eggs
Overlapping Generations
Eggs
Two-Spotted Spider Mites
Adult Females
Overlapping Generations
Adult Females
White Pine Weevil
Adults
Larvae
Pupae
Adults
Optimum Time For Treatment
Seasonal Occurrence of Life Stages


Pest/Disease
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov-Feb
Armillaria Root Rot
Symptoms/Monitor
Control
Fir-Fern Needlerust
Symptoms/Monitor
Control
Phytophthora Root Rot
Symptoms/Monitor
Control
Rhabdocline Needlecast
Symptoms/Monitor
Control
Rhizosphaera Needlecast
Symptoms/Monitor
Control
Sirococcus Twig Blight
Symptoms/Monitor
Control
Spruce Canker
Symptoms/Monitor
Optimum Time For Treatment
Seasonal Occurrence


Pest/Disease
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov-Feb
Swiss Needlecast
Symptoms/Monitor
Control
Weir's Cushion Rust
Symptoms/Monitor
Control
Optimum Time For Treatment
Seasonal Occurrence

**Christmas Tree IPM Scouting Report**
**Late March - April**

Grower _____ Date _____ Field _____ Scout _____

| Tree Type | Pest | #Plants Examined | #Plants Detected | Comments |
|---|---|---|---|---|
| Douglas Firs | Rhabdocline Needlecast | | | Examine 50 random trees for purple/brown banding on last year's growth. Rogue severely affected trees before May 1st. |
| | Swiss Needlecast | | | Look for black fuzzy fruiting bodies on green and yellow needles. |
| | White Pine Weevil | | | Look for adults on warm days in late March. In April look for small round holes or pitch flow to terminal leader. |
| | Douglas Fir Needle Midge | | | Check traps for adult midges. |
| Spruces | White Pine Weevil | | | Look for adults on warm days in late March. In April look for small round holes or pitch flow to terminal leader. |
| | Eastern Spruce Gall Adelgid | | | Look for small green/grey aphid-like insects with a white cottony covering near end buds. |
| | Cooley Spruce Gall Adelgid | | | Look for cottony masses near terminal buds. |
| | Spruce Needleminers | | | Look for larvae in webbed nests on needles. |
| | Spruce Bud Scale | | | Look for immatures on undersides of needles and/or bud scales. |
| | Eriophyid (Spruce) Rust Mite | | | Look for tiny red eggs on undersides of needles. |
| | Rhizosphaera Needlecast | | | Look for black fuzzy fruiting bodies on green and yellow needles. |
| | Spruce Canker | | | Look for flagging of lower branches. Pitch exuded from canker sites. |
| | Weir's Cushion Rust | | | Look for bright orange blisters on one year old needles. |
| Balsam, Fraser, Canaan Firs | Balsam Gall Midge | | | Look for thin foliage and bare branches. |
| | Balsam Twig Aphid | | | Look for tiny black eggs with fine white hairs. Look for yellow/green nymphs near buds. |
| | Saratoga Spittlebug | | | Look for tiny, black eggs on bud scales. |
| | Fir-Fern Needle Rust | | | Look for elongated chlorotic spots between the veins on the upper surface of bracken fern fronds. |
| | Phytophthora Root Rot | | | Look for yellowing needles, wilting, cinnamon-brown needles. |
| All Tree Types | Elongate Hemlock Scale | | | Look for white males, amber colored females on underside of needles, woolly appearance to needles. Look for yellow banding on upper surface of needle. |
| | Pales Weevil | | | Look for adults on freshly killed stumps. |
| | Spruce Budworm | | | Look for larvae in webbed clusters of brown needles attached to twig with silk. |
| | Spruce Spider Mite | | | Look for tiny red, flat, pointed eggs with a thin hair on the top of the egg. Tap 3 inner branches (from the lower half of the tree); if 10 or more mites per tap, treat. |

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| | Armillaria Root Rot | | | Look for white fungal stands (mycelial fans) between the bark and the wood. |

# Christmas Tree IPM Scouting Report
# May

Grower _____ Date _____ Field _____ Scout _____

| Tree Type | Pest | #Plants Examined | #Plants Detected | Comments |
|---|---|---|---|---|
| Douglas Firs | Rhabdocline Needlecast | | | Look for blister-like fruiting bodies on last year's growth. When new growth is ½" long begin treatment. |
| | Swiss Needlecast | | | Look for black fuzzy fruiting bodies on green and yellow needles. Time treatments as for Rhabdocline. |
| | White Pine Weevil | | | Look for pitch flow to terminal leader. Look for small white legless larvae with a brown head. Remove infested terminals and destroy. |
| | Douglas Fir Needle Midge | | | In early May check traps for adult midges. |
| | Cooley Spruce Gall Adelgid | | | Look for cottony tufts on needles. |
| Spruces | White Pine Weevil | | | Look for pitch flow to terminal leader. Look for small white legless larvae with a brown head. Remove infested terminals and destroy. |
| | Eastern Spruce Gall Adelgid | | | Look for pineapple shaped swellings (galls) at the base of new growth. Prune out galls. |
| | Cooley Spruce Gall Adelgid | | | Look for cigar shaped swellings (galls) at the tip of new growth. Prune out galls. |
| | Spruce Needleminer | | | Look for larvae in webbed nests on needles. |
| | Spruce Bud Scale | | | Look for immatures on undersides of needles and/or bud scales. |
| | Eriophyid (Spruce) Rust Mite | | | Look for tiny red eggs on undersides of needles. |
| | Rhizosphaera Needlecast | | | Look for black fuzzy fruiting bodies on green and yellow needles. |
| | Spruce Canker | | | Look for flagging of lower branches. Pitch exuded from canker sites. |
| | Weir's Cushion Rust | | | Look for bright orange blisters on one year old needles. Begin treatment when 10% budbreak is complete. |
| Balsam, Fraser, Canaan Firs | Balsam Gall Midge | | | Look for orange adult midges (resemble mosquitoes) laying eggs on elongating shoots. |
| | Balsam Twig Aphid | | | Look for yellow/green nymphs near buds. Look for twisted, distorted foliage thick with honeydew. |
| | Saratoga Spittlebug | | | Look for "spittle" on weeds and vegetation. |
| | Fir-Fern Needle Rust | | | Look for yellow blotches on the upper surface of 1 year old and older needles. |
| | Phytophthora Root Rot | | | Look for yellowing needles, wilting, cinnamon-brown needles. |
| All Tree Types | Elongate Hemlock Scale | | | Look for white males, amber colored females on underside of needles, woolly appearance to needles. Look for yellow banding on upper surface of needle. |
| | Pales Weevil | | | Look for adults on freshly killed stumps. |
| | Pine Spittlebug | | | Look for "spittle" on trees. |
| | Spruce Budworm | | | Look for larvae in webbed clusters of brown needles attached to twig with silk. |
| | Spruce Spider Mite | | | Look for tiny red, flat and pointed eggs with a thin hair on the top of the egg. Tap 3 inner branches (from the lower half of the tree) per tree; if 10 or more mites per tap, treat. |
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| | Two-Spotted Spider Mite | | | Perform a tap test. Look for dark green to black spot on either side of body. Produce copious amounts of webbing. Prefers hot dry conditions. Needles appear stippled. |
| | Armillaria Root Rot | | | Look for white fungal strands (mycelial fans) between the bark and the wood. |

# Christmas Tree IPM Scouting Report
# June

Grower _____ Date _____ Field _____ Scout _____

| Tree Type | Pest | #Plants Examined | #Plants Detected | Comments |
|---|---|---|---|---|
| Douglas Firs | Rhabdocline Needlecast | | | Look for ruptured spore cases on last year's growth. |
| | Swiss Needlecast | | | Look for yellow banded needles. Mottling of 1 year old needles. Yellowing and casting of 2-3 year old needles. Examine lower branches. |
| | White Pine Weevil | | | Look for pitch flow to terminal leader. Look for small white legless larvae with a brown head. Remove infested terminals and destroy. |
| | Cooley Spruce Gall Adelgid | | | Look for crooked needles with yellow spots at the bend in the needle on last year's growth. |
| | Douglas Fir Needle Midge | | | Look for light green banding on needles. |
| Spruces | White Pine Weevil | | | Look for pitch flow to terminal leader. Look for small white legless larvae with a brown head. Remove infested terminals and destroy. |
| | Eastern Spruce Gall Adelgid | | | Look for swollen pineapple shaped galls at the base of the twig. Prune out galls. |
| | Cooley Spruce Gall Adelgid | | | Look for cigar shaped galls on the tips of twigs. Prune out galls. |
| | Spruce Needleminer | | | Look for dead needles webbed together against the twig. |
| | Spruce Bud Scale | | | Look for "globe-like" brown scales at bud clusters. Open scales to look for pink colored eggs. Look for crawlers. |
| | Eriophyid (Spruce) Rust Mite | | | Look for tiny red eggs on undersides of needles. |
| | Rhizosphaera Needlecast | | | Look for banding on this year's needles. |
| | Spruce Canker | | | Look for dead (flagged) branches on the lower portion of tree. Look for excessive pitch on affected branches. |
| | Weir's Cushion Rust | | | Look for orange-Yellow pustules on last year's growth. |
| Balsam, Fraser, Canaan Firs | Balsam Gall Midge | | | Look for swollen yellow colored galls at the base of this year's growth. |
| | Balsam Twig Aphid | | | Look for green winged and wingless aphids covered with a powdery wax. Look for twisted, distorted foliage thick with honeydew. Many predators may be seen feeding on the aphids. |
| | Saratoga Spittlebug | | | Look for adults who are boat-shaped and orange in color. They will jump when approached. |
| | Fir-Fern Needle Rust | | | Look for yellow blotches on the upper surface of 1 year and older needles. |
| | Phytophthora Root Rot | | | Look for yellowing needles, wilting, cinnamon-brown needles. |
| All Tree Types | Elongate Hemlock Scale | | | Look for white males, amber colored females on underside of needles, woolly appearance to needles. Look for yellow banding on the upper surface of needles. |
| | Pales Weevil | | | Look for adults on freshly killed stumps. |
| | Spruce Budworm | | | Look for pupae in webbed clusters of brown needles attached to the twig with silk strands. |
| | Spruce Spider Mite | | | Look for tan or salmon colored eggs. |
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| | Two-Spotted Spider Mite | | | Perform a tap test. Look for dark green to black spot on either side of body. Produce copious amounts of webbing. Prefers hot dry conditions. Needles appear stippled. |
| | Armillaria Root Rot | | | Look for fan shaped fungal strands (mycelial fans) under the bark at the base of the tree. |

# Christmas Tree IPM Scouting Report
# July to August

Grower _____ Date _____ Field _____ Scout _____

| Tree Type | Pest | #Plants Examined | #Plants Detected | Comments |
|---|---|---|---|---|
| Douglas Firs | Rhabdocline | | | Look for yellow banded needles. |
| | Swiss Needlecast | | | Look for yellow banded needles and mottling of 1 year old needles. |
| | White Pine Weevil | | | Wilting or drooping terminal leader. Look for "chip cocoons" in oval niches on infested terminals. Round exit holes will appear by August. Remove infested terminals and destroy. |
| | Douglas Fir Needle Midge | | | Look for brown, bent swollen needles. |
| | Cooley Spruce Gall Adelgid | | | Look for crooked needles with yellow spots at the bend in the needle. Look for cottony tufts on needles. |
| Spruces | White Pine Weevil | | | Wilting or drooping terminal leader. Look for "chip cocoons" in oval niches on infested terminals. Round exit holes will appear by August. Remove infested terminals and destroy. |
| | Eastern Spruce Gall Adelgid | | | Galls will turn brown after adult emergence. Prune out galls. |
| | Cooley Spruce Gall Adelgid | | | Galls will turn brown after adult emergence. Prune out galls. |
| | Spruce Needleminer | | | Look for dead needles webbed together against the twig. |
| | Spruce Bud Scale | | | Look for brown, flat crawlers. |
| | Eriophyid (Spruce) Rust Mite | | | Look for tiny red eggs on undersides of needles. |
| | Rhizosphaera Needlecast | | | Look for banding of this year's needles. Look for casting of previous year's needles. |
| | Spruce Canker | | | Look for flagging of lower branches and excessive pitch at canker sites. |
| | Weir's Cushion Rust | | | Look for yellow spots or banding on current growth. |
| Balsam, Fraser, Canaan Firs | Balsam Gall Midge | | | Look for swollen growths on individual needles. |
| | Balsam Twig Aphid | | | Look for tiny eggs with a woolly covering in bark crevices near buds. |
| | Balsam Gall Midge | | | Look for swollen growths on individual needles. |
| | Saratoga Spittlebug | | | Look for tiny, black eggs on the bud scales. |
| | Fir-Fern Needle Rust | | | Look for white spore pustules on the undersides of needles. |
| | Phytophthora Root Rot | | | Look for yellowing needles, wilting, cinnamon-brown needles. |
| All Tree Types | Elongate Hemlock Scale | | | Look for white males, amber colored females on underside of needles, woolly appearance to needles. Look for yellow banding on the upper surface of needles. |
| | Pales Weevil | | | Look for adults feeding on tender bark of shoots and twigs. |
| | Spruce Budworm | | | Look for larvae in webbed clusters of brown needles attached to the twig with silken strands. |
| | Spruce Spider Mite | | | Look for tan or salmon colored eggs. |
| | Two-Spotted Spider Mite | | | Perform a tap test. Look for dark green to black spot on either side of body. Produce copious amounts of webbing. Prefers hot dry conditions. Needles appear stippled. |
| | Armillaria Root Rot | | | Look for white fungal strands (mycelial fans) between the bark and the wood. |

# Christmas Tree IPM Scouting Report
# September - October

Grower _____ Date _____ Field _____ Scout _____

| Tree Type | Pest | #Plants Examined | #Plants Detected | Comments |
|---|---|---|---|---|
| Douglas Firs | Rhabdocline Needlecast | | | Yellow banded needles. Mottling of needles of current year's growth. |
| | Swiss Needlecast | | | Yellow banded needles. Mottling of needles of current year's growth. |
| | White Pine Weevil | | | Wilting or drooping terminal leader. Remove infested terminals and destroy. |
| | Douglas Fir Needle Midge | | | Look for brown, bent swollen needles. |
| | Cooley Spruce Gall Adelgid | | | Crooked needles with yellow spots at the bend in the needle. Tufts of cotton on needles. |
| | Pine Needle Scale | | | Look for "flecks of snow" on the needles |
| Spruces | White Pine Weevil | | | Wilting or drooping terminal leader. Remove infested terminals and destroy. |
| | Eastern Spruce Gall Adelgid | | | Galls will turn brown after adult emergence. Prune out galls. |
| | Cooley Spruce Gall Adelgid | | | Galls will turn brown after adult emergence. Prune out galls. |
| | Spruce Needleminer | | | Look for tanned and/or dead needles webbed together against the twig. |
| | Spruce Bud Scale | | | Look for globe-like scale coverings on new growth. |
| | Eriophyid (Spruce) Rust Mite | | | Look for carrot-shaped tiny orange colored mites feeding on undersides of leaves. |
| | Rhizosphaera Needlecast | | | Banding of needles on this year's growth. |
| | Spruce Canker | | | Look for flagging of lower branches and pitch exuded from canker sites. |
| | Weir's Cushion Rust | | | Yellow spots or banding on current year's growth. |
| Balsam, Fraser, Canaan Firs | Balsam Gall Midge | | | Look for overwintering pupae in the leaf litter beneath trees. |
| | Balsam Twig Aphid | | | Look for tiny eggs covered with waxy rods in bark crevices. |
| | Saratoga Spittlebug | | | Look for small, brown flecks or puncture marks on twigs. |
| | Fir-Fern Needle Rust | | | Look for dried up needles cast from the tree. |
| | Phytophthora Root Rot | | | Look for yellowing needles, wilting, cinnamon-brown needles. |
| | White Pine Weevil | | | Wilting or drooping terminal leader. Round exit holes. Remove infested terminals and destroy. |
| All Tree Types | Elongate Hemlock Scale | | | Look for white males, amber colored females on underside of needles, woolly appearance to needles. Look for yellow banding on the upper surface of needles. |
| | Pales Weevil | | | Look for adults feeding on tender bark of shoots and twigs. |
| | Spruce Budworm | | | Look for larvae in webbed clusters of brown needles attached to the twig with silken strands. |
| | Spruce Spider Mite | | | Tap 3 inner branches (from the lower half of the tree) per tree; if 10 or more mites per tap, treat. |
| | Two-Spotted Spider Mite | | | Perform a tap test. Look for dark green to black spot on either side of body. Produce copious amounts of webbing. Prefers hot dry conditions. Needles appear stippled. |
| | Armillaria Root Rot | | | Look for white fungal strands (mycelial fans) underneath the bark at the base of trees. Look for honey–colored mushrooms at the base of dead trees. |

## Balsam Gall Midge, *Paradiplosis tumifex*

Hosts: Balsam and Fraser fir

Identification: Adults are tiny orange/reddish midges (flies) (Fig. 1). Larvae are tiny yellowish/pinkish colored legless maggots (Fig.2).

Fig. 1

Fig. 2

Description of Damage: Swollen growths (galls) will be present on the base of current year's needles. Twigs will be devoid of needles in the fall, especially towards the upper crown of the tree. If there is a heavy infestation, there may be several galls per needle (Fig. 3).

Fig. 3

Life Cycle: The pupal stage overwinters in the leaf litter (duff) underneath the tree. Pupation occurs in spring and adults emerge as new buds are expanding. Eggs are laid on the buds. After hatching larvae crawl to the base of newly expanding needles and begin to feed. Chemicals secreted during this feeding cause the plant tissue to swell around the larva forming the distinctive gall. Feeding by the midge larvae causes needles to yellow, die and fall from the tree. This damage (galls) is evident throughout the summer. Yellowed needles containing larvae fall to the ground in early autumn. Larvae leave the galls, pupate and overwinter in the duff beneath the tree.

Management Techniques:

Scouting Methods:

Emergence traps for adults should be placed beneath previously infested trees in early May. Traps can be simple bottomless wooden boxes with a hole on the side replaced with a clear vial or Plexiglas so it is exposed to light. Adults will be attracted to the light.

Look for galls June to October.

IPM Strategies:

A gall wasp (*Platygaster spp.)* (Fig. 4) may provide biological control. If only a few galls are present, leave them in place to conserve natural enemies. The decision to spray is subjective and based on how heavily the tree is infested.

Fig. 4

Infestations tend to be cyclical. They will occur for 3-4 years and not be present for several years thereafter.

Remove and burn heavily infested branches or trees before infested needles drop to the ground in late summer or early autumn.

Treat in May, 120 – 299 GDD, PPI – Japanese quince, saucer magnolia. Treatment should be made within 7 days of adult emergence, after budbreak and before needles are 1 inch long. Treatment is targeted to adults or larvae before the gall forms.

## Balsam Twig Aphid, *Mindarus abietinus*

Hosts: All species of fir (especially balsam and Fraser), occasionally some spruce and pine species.

Identification: Tiny (less than 1/16 “) black eggs covered with fine white hairs (Fig. 1). Nymphs are yellow. Adults may be winged or wingless and gray (Fig. 2, 3).

Description of Damage: Tiny black eggs with fine white hairs can be seen in bark crevices. Tiny yellow-green nymphs can be found on expanding buds. Groups of aphids with a white waxy covering can be seen at the base of needles (Fig.4). Twisted, stunted, sticky (from honeydew) silvery needles are evident on newly expanding needles (Fig. 5).


Fig. 1


Fig. 2


Fig. 3


Fig. 4


Fig. 5

Life Cycle: Eggs are usually found on the underside of the previous year's growth within two inches of buds. Nymphs hatch in April and by May begin to feed on newly expanding needles. Late spring to early summer, green winged and wingless aphids covered in a waxy and honeydew covering are evident on current year's needles. Eggs are laid in bark crevices and the base of the current year's growth to overwinter.

Management Techniques:

Scouting Methods:

Prior to budbreak, perform a beat test using a black cloth and place it under the outer ten inches of mid-crown foliage. Sample a minimum of 15 trees on at least two sides of the tree. If more than two aphids are present and trees were damaged the previous year, treatment may be necessary.

IPM Strategies:

If trees are three years or less from market, then judicious management is recommended. If not, shearing will most likely remove distorted damage.

Avoid use of nitrogen fertilizers on young trees and/or before budbreak as it will promote aphid build-up.

Ladybird beetles, syrphid fly larvae, and lacewing larvae may provide adequate biological control if damage can be tolerated.

The first generation does little feeding, but is most susceptible to treatment. Pesticide applications should be made on warm days before budcaps loosen. Late April to early May, 30-100 GDD. PPI – boxelder, star magnolia. Usually, once the damage is evident it is too late to achieve control.

## Cooley Spruce Gall Adelgid, *Adelges cooleyi*

Hosts: Colorado blue and occasionally other spruce species; Douglas fir

Identification: Adults are small, black aphid-like insects. Immatures are wingless and will be found on the base of spruce needles in spring. Winged adults and immatures covered in a cottony mass may be found on Douglas fir in summer.

Description of Damage: On spruce look for cigar shaped galls encompassing the entire tip of new shoots in summer (Fig. 1). Galls will appear green at first and turn brown by August (Fig. 2). On Douglas fir look for yellow spots, bent needles, or small cottony masses on the undersides of needles in mid-summer (Fig.3,4).

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Life Cycle:

On Spruce: Immature females overwinter near twig terminal end buds (Fig. 5). In early spring they lay eggs which are encased in a white, cottony mass near the end buds. Nymphs hatch and begin feeding on newly expanding needles producing the galls. In mid-summer, galls dry up and newly emerged winged adults will fly to Douglas fir where they will lay eggs on the needles and produce a white, cottony mass. Winged forms return from Douglas fir in the fall to produce eggs which hatch into immature females and over winter. Newly emerged adelgids must fly to Douglas fir to complete their life cycle.

On Douglas fir: Adelgids overwinter as immature females on the undersides of needles. In early spring (March – mid April) they become active and transform into wingless females covered with a white cottony tuft. These females lay 10 – 30 eggs in the tufts and produce two types of offspring – winged asexual females and wingless asexual females. Both forms move to newly expanding needles and begin to feed. It is the spring feeding which causes most of the damage seen on Douglas fir. By mid-summer newly emerged winged adults arrive from newly emerged galls on blue spruce and produce the immature females which will overwinter. All the forms can be found on Douglas fir and the life cycle can be completed on Douglas fir only.

Fig. 5

Management Techniques:

Scouting Methods:

Look for overwintering immature females on twig terminal and buds in early spring.

Newly forming galls are first pink and then turn green. Prune out galls on spruce before they turn brown.

In spring look for cottony tufts on Douglas fir needles.

IPM Strategies:

Avoid planting Douglas fir near spruce. Do not fertilize infested trees.

There are no effective natural enemies.

Spray spruce mid-to late April, 22-81 GDD, PPI Japanese Quince. Again mid-September, 1850-1950 GDD, PPI-Hydrangea paniculata.

Spray Douglas fir early May, 120-190 GDD and again late July to early August, 1500-1775 GDD.

## Douglas fir Needle Midge, *Contarinia pseudotsugae*

Hosts: Douglas fir

Identification: Adults are very tiny midges (flies) about 1/8" long (Fig. 1). Larvae are small white maggots without a distinct head capsule (Fig. 2).

Description of Damage: Larvae feeding in the needles during the summer months cause a gall to form (Fig. 3). Typically, the needles at the site of the gall are bent. The damaged area is initially pale in color (Fig. 4), but as the season progresses, the affected area turns brown (Fig. 5). Emergence holes are irregular in shape and may appear to resemble a slit or rupture (Fig. 6). Douglas fir needle midge damage may at first glance, resemble Rhabdocline damage (Fig. 7). If the needle is looked at from the side, it appears to be swollen. Douglas fir needle midge may also resemble Cooley spruce gall adelgid damage (Fig. 8). Cooley spruce gall adelgid damage may not cause chlorosis at the point where the needle is bent. In addition, cast skins of the adelgid are usually present at the site of the bend in the needle. Needle midge damage in late fall will show an emergence hole (Fig. 5).


Fig. 1

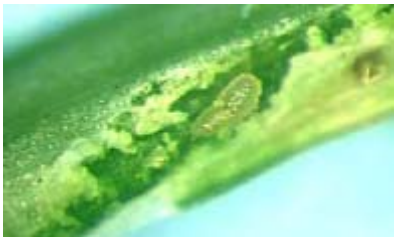
Fig. 2

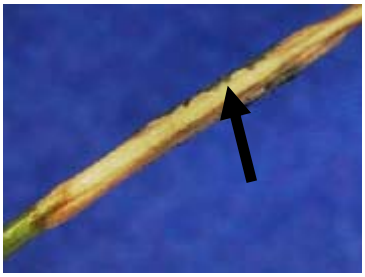
Fig. 3


Fig. 4


Fig. 5


Fig. 6


Fig. 7


Fig. 8

Life Cycle: Larvae overwinter in soil underneath infested trees. In early spring, larvae pupate and adult midges emerge (usually late April or early May, however there is not enough data known about the life cycle of this midge) as buds begin to expand. Females place several orange eggs on expanding and elongating needles. Larvae chew into the needle and their feeding causes a small gall to form. In late fall, larvae emerge from the undersides of the needle and drop to the soil to overwinter.

Management Techniques:

Scouting Methods:

Look for brown, bent swollen needles in summer. In Fall, look for small emergence holes at the site of the gall.

Use traps to determine adult emergence (see trap description under Balsam Fir needle midge. Place traps under branches of an infested tree starting in mid-April.

IPM Strategies:

Control must be aimed at adults before they lay eggs. When adults are found in traps, begin treatment immediately. Studies done in Pennsylvania indicate the most important time to protect the new growth would be between the $5^{th}$ and $21^{st}$ day after the first adults are seen in the traps.

## Eastern Spruce Gall Adelgid, *Adelges abietis*

Hosts: Norway, red, white, Serbian spruce

Identification: Adelgids are tiny aphid-like insects. Eggs are black and are surrounded by a cottony mass found at the base of the bud (Fig. 1). Nymphs are white and encased in separate cells in the gall.

Description of Damage: Pineapple shaped galls appear at the base of new shoots (Fig. 2).

.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Life Cycle: Females overwinter near the end buds and lay eggs at the base of buds in early spring (Fig. 1). Eggs hatch and the nymphs migrate to the base of buds and begin to feed forming the characteristic pineapple shaped gall (Fig. 2, 3, 4). Galls mature in mid to late summer (Fig. 5) and newly emerged winged adults begin laying eggs usually near the needle tips. The eggs hatch and immature females will overwinter near the buds.

Fig. 5

Management Techniques:

Scouting Methods:

Look for overwintering females at the end buds and base of needles. Look for pineapple shaped galls at the base of new shoots starting in early summer.

IPM Strategies:

There are no effective parasites or predators.

Where feasible, prune out galls before they mature.

Spray applications mid-April to early May, 22-170 GDD, PPI – boxelder, Periwinkle.

**Elongate Hemlock Scale, *Fiorinia externa***

Hosts: Hemlock, true firs, Douglas fir, spruce, pines

Identification: This armored scale is about 1/8 inch long. Male scale covers are white, while female scale covers are amber colored. Eggs and crawler stage are yellow. Mature male adults are tiny and winged.

Description of Damage: White males, amber colored females and tiny yellow crawlers can be observed on the lower needle surface (Fig. 1). Feeding causes yellow banding on the upper surface of the needle (Fig. 2). Crawlers secrete a waxy filament and when populations are high, lower needles may exhibit a woolly (snowy) appearance (Fig. 3).


Fig. 1


Fig. 2


Fig. 3

Life Cycle: Adults females overwinter on the undersides of needles. Eggs are laid throughout most of the growing season. Crawlers emerge several weeks after eggs are laid, travel to other parts of the tree, settle down and begin feeding. After three to four weeks, crawlers molt. About one month after the last molt, adults emerge and mate. Egg laying begins about 8 weeks after adult emergence. Although crawler abundance is highest in May, crawlers (and other developmental stages) may be seen on trees year round. Wind may blow crawlers to other host trees.

Management Techniques:

Scouting Methods: Usually observed on the bottom 1/3 of the tree. Look for tiny yellow crawlers late May through mid-June. Look for amber colored females and white males.

IPM Strategies:

Several predators and parasites may provide limited control.

Dormant spray, 7-120 GDD. Crawlers best controlled in late May through June, 360-700 GDD, PPI – Tartarian honeysuckle, beautybush.

**Special Note:** This pest is difficult to control as there is no peak crawler emergence, multiple stages of the life cycle are present throughout the growing season and eggs are protected in pupillarial case beneath female. Careful scouting and monitoring of this pest is imperative. Most effective control is achieved with systemic insecticides. For current pesticide recommendations please check the Cornell *Pest Management Guide for Commercial Production and Maintenance of Trees and Shrubs*. This annual publication can also be viewed online at http://ipmguidelines.org/treesandshrubs.

## Eriophyid (Spruce) Rust Mites – *Nalepella halourga*

Hosts: Spruce

Identification: These mites are almost impossible to see with the naked eye. Adults are reddish-purple about .010 inch long, carrot shaped with a pair of long hairs (setae) on the dorsal surface. These hairs point forward as the mites move on the needle surface. As with all other eriophyid mites, there are only two pairs of legs, not four pairs as found on spider mites. Eggs are very, very tiny red and are laid in clusters on the undersides of needles.

Description of Damage: Mites prefer new growth and usually inhabit the top of the tree. Affected shoots appear russeted or bronze in color.

Life Cycle: Eggs overwinter and are evident on the host from December through February (Fig. 1). As soon as plant growth begins newly hatched nymphs will begin to feed. The mite goes through two active stages before transforming into an adult. This mite is a cool weather pest preferring early spring and fall. It will emerge prior to spruce spider mites. There may be six or more generations per year.

Fig. 1

Management Techniques:

Scouting Methods: Look for overwintering eggs from December through February. Clusters of tiny red eggs will be present on the needles on the underside of the branch. Large numbers of eggs will create a rusty area on the needle. 10 or more eggs per needle, indicates the potential for high populations.

IPM Strategies:

Predatory mites may keep this pest in check. Their presence usually indicates no control is necessary.

## Northern Pine Weevil, *Pissodes approximatus*

Hosts: All pines, spruces and occasionally Douglas fir

Identification: Adults are a small reddish-brown weevil about 1/3 inch long with white spots on its wing covers (Fig. 1). Larvae are small, cream colored with a brown head capsule, legless, C-shaped about 1/3 inches long (Fig. 2).


Fig. 1


Fig. 2

Description of Damage: Adults are typically night feeders (or on overcast days) and feed on the inner bark of twigs and small branches usually in the lower portion of the tree above the root collar zone, though they can also be found throughout the tree. They prefer newly dead wood or trees weakened by stress or other pests/diseases. They chew small round holes in the outer bark from which they remove large irregular patches of inner bark. Pitch may exude from the drilled holes. This feeding causes tip dieback and creates a “flagged” effect. Flagging can occur anywhere on the tree. Larvae feed on freshly dead wood and construct chip cocoons (pupation chambers made of fine sawdust) which are about ¼ inch long (Fig. 3). Larval damage is the most destructive. Damage from this weevil is usually considered minor but feeding on seedlings may cause mortality.


Fig. 3

Life Cycle: Northern pine weevil primarily overwinters as an adult in the leaf litter underneath trees. Occasionally larvae and pupae will also overwinter in the inner bark of infested trees. Adults start feeding in early April and after about three weeks mate. The female chews a hole in the bark of freshly dead or dying wood to lay a single egg. Eggs hatch within two weeks and larvae burrow into the cambium layer where they remain and feed. Larval feeding continues until about mid-July when mature larvae chew into the sapwood to construct their chip cocoons. Adults emerge by mid-August and begin to feed on living tissue by making small punctures through the bark. This feeding occurs until about the end of October before the adults enter the overwintering stage.

## Management Techniques:

### Scouting Methods:

Look for feeding damage (holes and pitch) on newly killed wood.

Look for flagged shoot tips.

### IPM Strategies:

To eliminate potential breeding sites remove dead or dying trees and fresh stumps before late spring.

At harvest leave one whorl of live pest/disease free branches on each stump. This discourages weevil feeding. Remove these stumps within three years.

Cover stumps with soil or plastic.

Treat stumps and surrounding soil (2-3 inches around stump) April through early May, 7-192 GDD, PPI – pussy willow, boxelder.

## Pales Weevil, *Hylobius pales*

Hosts: Eastern white and Scotch pine, Douglas fir, true firs and some spruces.

Identification: Adults are reddish-brown weevils, 1/3 inch long (Fig. 1). Larvae are about ½ inch long, white and C-shaped (Fig. 2).

Description of Damage: Adults feed on the stem bark of seedlings and on the shoot and branch bark of older trees. Adult feeding will cause pits or holes on the stem or branch (Fig. 3). On older trees these pits or holes are at the base of dying shoot tips. Severe feeding can girdle and kill shoots. Larvae can be found beneath the bark of freshly killed stumps. Stumps are a constant source of breeding. Females are attracted to the resin of new stumps.


Fig. 1


Fig. 2


Fig. 3

Life Cycle: Most overwinter as adults in the leaf litter beneath trees though some will overwinter as larvae on roots. They emerge from April to June and are attracted to the resin of freshly cut stumps. They feed on nearby tree shoots primarily at night and hide in the leaf litter during the day. Mating and oviposition take place in the roots of stumps or dying trees. Larvae feed in the bark of dying roots until they pupate and emerge as adults in late summer or early fall. Newly emerged adults will feed on tender bark of shoots and twigs before moving to the leaf litter to overwinter.

## Management Techniques:

### Scouting Methods:

When night temperatures are 50°F (April to September), place a white sheet under the tree after dark and shake the tree. If adults are present they will fall onto the sheet.

Bait with freshly cut pine stems on the ground near trees. Adults can be found under these cut pieces during the day.

### IPM Strategies:

Delay replanting of heavily cut fields for two years.

Eliminate newly cut stumps in early spring.

When harvesting, leave one whorl of live, pest-free branches on the stump to keep it alive and repel weevils. Destroy these stumps within three years.

Spray young twigs and areas of tender bark April, 7-121 GDD, PPI – silver maple, star magnolia. Also late August to early September.

## Pine Needle Scale, *Chionaspis pinifoliae*

Hosts: White, mugo and Scots pine, spruce, Douglas fir, eastern red cedar, and all other species of pines.

Identification): Crawlers (nymphs) are reddish, less than 1/32 inch long. Adult males are pure white, about 1/25 of an inch long, with single pair of wings. Mature females are about 1/10 of an inch in length, reddish beneath the white scale covers, wingless and oyster shaped in appearance with a small orange, nipple-like structure (exuvim) at the narrow end.

Description of Damage: Infested trees appear almost white from a distance as if flecks of snow are covering the needles. Extensive feeding causes needles to turn brown and drop.

Summary of Life Cycle: Reddish eggs are deposited on needles late August to September. Eggs overwinter under the female scale covering. Reddish crawlers hatch in Mid-May to early June, traveling to new spots on the tree to begin to feed (Fig. 1). They may also be blown by the wind to new hosts. As they feed a new protective covering is formed. Nymphs molt several times. Males molt into a pre-pupa before emerging as a winged adult at the end of July-beginning of August. Females molt into a wingless nymph-like adult. Mating occurs and egg laying begins by late summer.

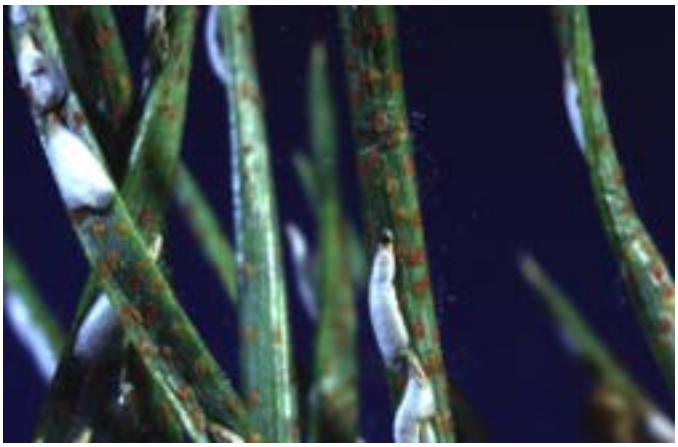

Fig. 1

Management Techniques:

Scouting Methods:

Look for white flecks on the needles before lilacs bloom in the spring. Check needles on lower branches first. Examine a few needles containing the white shells (tests) of the adult females. Pry back a dozen or more tests and look for tiny red crawlers.

IPM Management Strategies:

Common predators include the twice-stabbed lady beetle (*Chilocorus stigma*) (Fig. 2), another coccinellid beetle (*Microweisea misella),* a parasitic wasp, *Encarsia s*p. and a hyperparasitoid *Marietta* sp.

Fig. 2

Severely infested trees should be rogued. If the infestation is light and only several branches on a tree are affected, prune out affected branches. Also, remove affected windbreak or forest trees as they will serve as a reservoir for future infestations.

Applications directed at crawlers are most effective. Look for tiny red specks. Delay any chemical control of slight infestations on young trees if predators are abundant. Dormant treatment in April; late May for crawlers, 298-448 GDD, PPI – pussy willow, redbud; July, 1290 – 1917 GDD, PPI - abelia, butterfly bush.

## Saratoga Spittlebug, *Aphrophora saratogensis*

Hosts: Scotch and red pine; occasionally eastern white pine, Fraser fir and balsam fir.
*Note: Saratoga spittlebug is usually found only on Scots and red pines. There are reports in the literature of Fraser and balsam fir being affected. Hence the reason for inclusion in this guide.

Alternate Hosts for Saratoga Spittlebug: Sweetfern, brambles and other broadleaf weeds.

Identification: Adults are boat-shaped orange insects about 1/3 inch long with a white arrow-shaped marking on the head (Fig.1). Adults will jump when approached. Immatures (nymphs) are about ¼ inch long. The first four nymphal stages have a red abdomen with black markings on the side and the fifth nymphal stage is chestnut-brown in color. They resemble large aphids. The most characteristic identification is the spittle froth produced by the nymph. Nymphs are encased in this spittle (Fig. 2). Eggs are tiny, black and are found on the bud scales (Fig. 3).


Fig. 1


Fig. 2

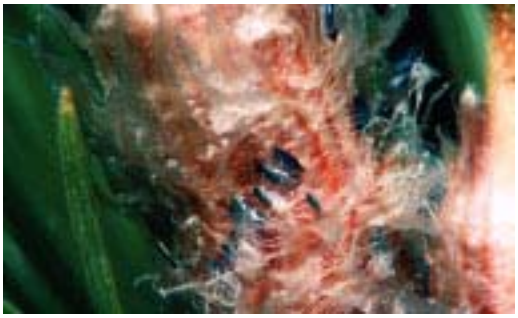
Fig. 3

**Special Note:** The pine spittlebug (*Aphrophora parallela*) is another spittlebug pest of Christmas trees. However their damage is usually just aesthetic. This pest does not have an alternate host and only feeds on conifers such as pine, native spruce, balsam fir and Douglas fir. If spittle is found on trees it is the pine spittlebug (Fig. 2) and not the Saratoga spittlebug. Adults of this insect do not have the characteristic arrow marking on the head and nymphs are creamy yellow to black in color.

Description of Damage: The first sign is the characteristic “spittle” or frothy mass visible on weeds, vegetation in mid-spring (Fig. 2). Nymphs do not feed on conifers but do feed on a wide variety of vegetation and weeds. Adults feed on new twigs of conifers and suck out plant juices with their piercing sucking mouthparts. When the bark of two year old growth (or older) is peeled back, small brown flecks or puncture marks will be visible in the wood. These flecks are feeding scars

(Fig. 4). New twigs will be stunted, yellow and eventually die. It can take up to three consecutive years of feeding for an entire branch to be killed by this pest (Fig. 5).


Fig. 4


Fig. 5

Life Cycle: Eggs overwinter under the scales of buds of conifers. Upon hatching they drop from the trees and early nymphal stages go to nearby vegetation such as brambles and weeds where they feed and produce spittle. The fifth nymphal stage feeds on sweetfern. All stages produce the conspicuous white spittle or froth. Adults emerge in late June and move to conifers to feed. Adults prefer to feed in the upper crown of the tree. Eggs are laid from July to late August. This pest requires an alternate host to complete its life cycle. Sweetfern is an important alternate host (Fig. 6).


Fig. 6

Management Techniques:

Scouting Methods:

Starting in May, look for conspicuous spittle on weeds and vegetation throughout the plantation.

Starting in July, look for adults on trees who will jump when disturbed.

Look for “flecks” or puncture marks (feeding scars) on older twigs.

IPM Strategies:

Winter and early spring weather conditions may influence population levels. Adverse weather conditions such as dry, hot weather where ground cover is sparse may affect populations. In late spring, short periods of low temperatures (low 20’s F.) may kill exposed nymphs.

Eliminate alternate hosts such as sweetfern, brambles and weeds. Mow often or use herbicides within 20 feet of crop trees.

Peel the bark off of 2-year old shoots and if more than 20 “flecks” per 4 inches of branch growth are present, treatment may be necessary.

Treat early to mid-May, 148 – 298 GDD, PPI – Japanese quince, redbud.

## Spruce Bud Scale, *Physokermes piceae*

Hosts: All spruces. Norway spruce is especially susceptible. Also some firs.

Identification: Adults are round, shiny and reddish/brown in color, up to 3/16 inches in diameter (Fig. 1). These scales can be mistaken for buds. They use this camouflage to escape detection and thus may be overlooked. Crawlers are brown and flat.

Fig. 1

Description of Damage: These sucking insects remove sap from the host. They will usually congregate at bud clusters. They excrete honeydew and thus sticky twigs covered with sooty mold will be present. If populations are large enough, shoots will die.

Life Cycle: Immatures overwinter on the undersides of needles and/or under bud scales. In spring when the weather warms up, they migrate to newly developing twigs and settle down to feed and continue development. At maturity females produce tiny pink colored eggs (usually in June) which are protected by the globe-like covering of the adult female. Eggs hatch throughout June and newly hatched crawlers emerge from the protective covering of the mother scale and then migrate to new growth and continue to feed for the rest of the season and overwinter. There is one generation a year.

Management Techniques:

Scouting Methods:
Carefully examine new shoots especially lower branches as infestations are more likely to be found in the lower branches. Look for globe-like adults clustered at the nodes of new twigs in mid-spring. Use a hand lens to check for eggs in June. Look for crawlers in June and July.

IPM Strategies:
Damage from this pest is usually minimal. However if trees are a year or two away from harvest, a heavy infestation may stunt or distort new twigs.

Lady beetles and other predators usually do a good job of controlling light infestations.

Where practical, prune out infested branches and destroy them.

Consider control if infestations are severe and/or if honeydew is a problem.
If necessary, apply pesticides in April (dormant), 22-121 GDD,
PPI – star magnolia. Again in late June to mid-July (verdant), 912 – 1388 GDD,
PPI – *Rhododendron maximum*.

## Spruce Budworm *Choristoneura fumiferana*

Hosts: All spruces and true firs. Pines and Douglas fir are occasionally attacked.

Identification: Adults are brown/gray moths with a wingspan of about one inch. Larvae are about one inch long when full grown, brown/gray with cream/yellow spots on the sides of the body and with a black head (Fig. 1).

Fig. 1

Description of Damage: Defoliated shoot tips with characteristic webbed clusters of brown needles attached to the twig with silk (Fig. 2). Caterpillars are found feeding within the webbed clusters. Larvae may also mine the previous year's needles in the spring. Later in spring they will enter expanding vegetative buds before shoot elongation begins. Green egg masses may be seen on the undersides of needles of current year's growth starting in mid-July (Fig. 3). From a distance heavily infested trees appear to have needle-less tips and look scorched.

Fig. 2

Fig. 3

Life Cycle: Larvae overwinter in their silken webbed clusters. Larvae continue to feed and pupate in this silken cluster. Adults emerge in early July and begin to lay eggs on the undersides of needles. Eggs hatch in mid-August and larvae begin to feed and build their cocoon-like shelter to overwinter in.

## Management Techniques:

### Scouting Methods:

Inspect trees in May as buds begin to expand. Examine one bud on each of 25 – 50 trees. If trees are within three years of harvest and 1 – 2 larvae per 10 spruce buds or 1 – 2 larvae per 20 fir buds are found, treatment may be necessary. Young trees (4 years or less) may need to be treated when an average of 2 – 4 larvae per 10 spruce buds or 1 -2 larvae per 10 fir buds are found.

### IPM Strategies:

Difficult to control when they are concealed in their silken webbed clusters.

Parasites and predators may keep populations in check but will not be enough in the event of an outbreak.

Treat Late April through Mid-June. GDD not available.

## Spruce Needleminers, *Endothenia albolineana* (Spruce Needleminer), *Epinotia nanana* (European or Green Spruce Needleminer)

Hosts: *Endothenia albolineana:* All spruces, but prefers Norway, white and blue.
*Epinotia nanana:* All spruces, but prefers Norway, Colorado and Engelmann.

Identification: Newly hatched larvae are pale yellow and will darken to a brownish-green color, ¼ inch long concealed in the needle and/or within webbed foliage (Fig. 1). Adults of both moths are small, 1/8 inch and mottled brown in color (Fig.2). These needleminers are difficult to tell apart. A useful field diagnostic tool to tell the two types apart is *Endothenia albolineana* are gregarious feeders and multiple larvae will be found in one webbed mass where as *Epinotia nanana* are solitary feeders.


Fig. 1


Fig. 2

Description of Damage: Larvae feed on the previous year's or old growth. Dead needles webbed together against the twig with fine strands of silk and frass can easily be seen without a hand lens (Fig.3). When webbed needles are pulled apart larvae may be either in the needles or within the webbing. Needles may be hollowed out and a small hole usually at the base of the needle will be evident.


Fig. 3

Life Cycle: *Note: Life cycles of these two pests are very similar. Therefore diagnosis of each type can be difficult. In general larvae overwinter in hollowed out needles protected by webbed needle "nests" covering the hollowed out needle. They resume feeding in the spring, feed for a few weeks and then pupate within the webbed mass. Adult moths emerge in May and June and after mating, the female deposits eggs shingle-style (overlapping) at the base of older needles. Eggs hatch in about two weeks and larvae immediately cut a hole in the base of the needle and begin to mine the inside of the needle.

## Management Techniques:

### Scouting Methods:

Look for the presence of tanned and/or dead needles webbed together against the twig anytime during the growing season.

### IPM Strategies:

Prune out infested twigs where possible.

A strong spray of water will dislodge the larvae and webs.

If trees are within three years of harvest and there is injury on more than 10% of the trees, treatment may be necessary.

Spray both old and new growth with a registered insecticide early to fourth week of June 448 – 802 GDD – PPI – mountain laurel, mock-orange.

## Spruce Spider Mites, *Oligonychus ununguis*

Hosts: Spruce, Douglas fir, True firs, Pines

Identification: Newly hatched mites are pale red and turn dark green to dark red after feeding. Overwintering eggs are red, spherical and pointed with a thin hair or stipe on the top of the egg (Figs. 1, 2). This stipe anchors the mite to the webbing (Fig. 2, red arrow). In season eggs are tan or salmon colored. Adults have fine hairs covering body (Fig. 2).

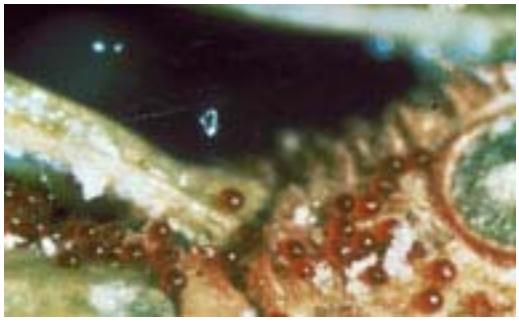

Fig. 1

Fig. 2

Description of Damage: Bronze colored shoots which upon closer inspection will show yellow stippling on needles (Fig. 3). Fine webbing between needles possible, but in general, this spider mite does not produce much silk. Spruce spider mites prefer older growth and will usually not feed on newer growth until it has hardened off. They are generally found in the bottom of the tree and work upward. Mites are active until the temperatures reach the mid-80's and then populations decline. Spruce spider mites prefer to feed on the base of needles of true firs and Douglas fir (Fig. 4).

Fig. 3

Fig. 4

Life Cycle: Mites overwinter as eggs on shoots. Six legged larvae hatch and go through several life stages until adulthood. Adults have 8 legs. Spruce spider mites are cool season feeders and are usually one of the earliest mites to feed in spring. Once temperatures consistently reach the mid 80's, feeding ceases and eggs will "over-summer". New generations will develop again in the fall upon the return of cooler temperatures. There can be several generations a year.

## Management Techniques:

### Scouting Methods:

Starting in early spring, perform a tap test on at least ten branches around the tree. Hold a piece of white paper underneath the branch and tap it on the paper. If more than 10 mites are present, control may be necessary.

Note: Adult spruce spider mites are usually dark and uniformly colored. Adult two-spotted spider mites have two areas of coloration. Spruce spider mite eggs are reddish and have a thin hair (stipe) protruding from the top of the egg. Two-spotted spider mite eggs are cream colored and do not have a stipe.

### IPM Strategies:

Steady stream of water drenching the interior of the tree will dislodge the mites.

Predaceous mites will feed on eggs and all stages of mites.

Dormant control in April, 7 – 121 GDD, PPI – pussy willow. Again mid to late May, 192 – 363 GDD, PPI – redbud. Again late August – September, 2375-2806 GDD, PPI witch hazel.

## Two-Spotted Spider Mites *Tetranychus urticae*

Hosts: Spruce, true firs, Douglas fir, pines

Identification: Eggs are milky white to cream colored when first laid turning yellow prior to hatch with many long hairs (setae). Newly hatched larvae have 6 legs. Later nymphal stages have 4 legs and adults have 8 legs with a dark-green to black spot on either side of the pale colored body (Fig. 1). These spots are actually internal waste accumulation that is visible when viewing them from above. Adult males are smaller than the females and their abdomen is more pointed (Fig. 2). In general, adults are 1/50 inch long.

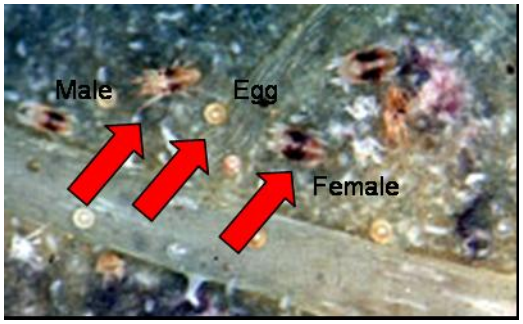

Fig. 1

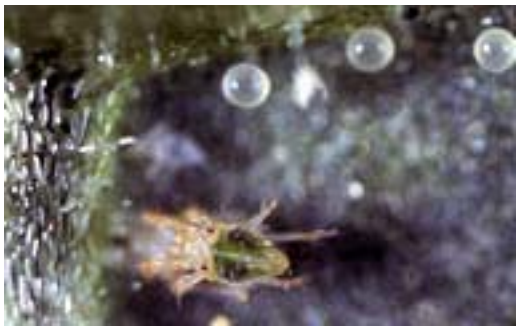
Fig. 2

Description of Damage: A stippled, bronzed effect on the upper surface of the needle (Fig. 3) and large amounts of webbing, cast skins and frass (Fig.4). Eggs are laid on the undersides of needles. These mites thrive in dry, hot weather.

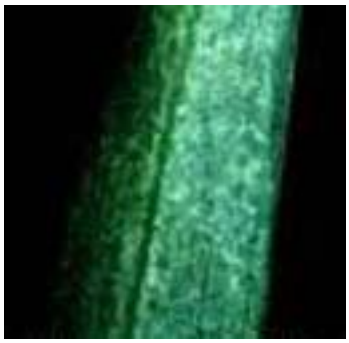
Fig. 3


Fig. 4

Life Cycle: Orange to orange-red females overwinter as adults under the bark scales or at the base of the tree in the duff. As soon as conditions are favorable for plant growth, females will feed and begin to lay eggs. Under ideal conditions, new generations may be formed in as little as five days. Up to 20 generations may occur in a growing season.

## Management Techniques:

### Scouting Methods:

Use the tap test method. Place a white sheet of paper under the branches and tap the branch onto the paper. If 10 or more mites per tap are observed, control may be necessary.

Note: Adult spruce spider mites are usually dark and uniformly colored. Adult two-spotted spider mites have two areas of coloration. Spruce spider mite eggs are reddish and have a thin hair (stipe) protruding from the top of the egg. Two-spotted spider mite eggs are cream colored and do not have a stipe.

### IPM Strategies:

Predators may keep small populations in check. When performing the tap test look for cream colored or red rapidly moving mites. If large numbers of these predatory mites are present, they may keep the population in check.

Dormant applications are not recommended. Late May – mid June, 363-618 GDD, PPI – Tartarian honeysuckle. Again mid July – mid-August, 1300 – 2000GDD, PPI – butterfly bush.

## White Pine Weevil, *Pissodes strobi*

Hosts: Eastern white and Scots pines, spruces, and hemlock, other pines and Douglas fir may also be attacked.

Identification: Adults are small brownish-black weevils, ¼ "long. Larvae are white with a curved body and about ¼" long.

Description of Damage: March to April: Small round holes or pitch flow on terminal leader where adults feed or lay eggs (Fig. 1). June to August: Characteristic "shepherd's crook" on terminal leader and possibly lateral branches on upper whorl (Figs. 2 & 3). Look for dead or wilting leaders starting in late June. White wood chip cocoons can be found under the bark (Fig. 4).

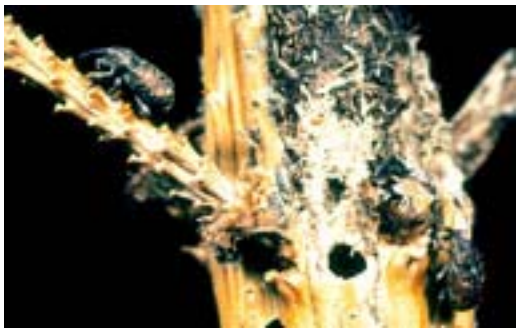

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Life Cycle: Adults overwinter in leaf litter on the ground. In late March, adults fly or crawl to a suitable host and lay eggs in a round hole. Larvae hatch soon after and feed under the bark, destroying vascular tissue (Fig. 5). Pupation takes place in chambers called chip cocoons (Fig. 4.) made from shredded wood and bark in the terminal leader. Adults emerge by mid-summer.


Fig. 5

Management Techniques:

Scouting Methods:
Late March to April: Look for small, round holes or pitch exudation on terminal leader.

June to August: Look for wilted leaders, puncture marks and/or pitch in the bark. Small larvae can be found under the bark in infested trees early on, and wood-chip pupal chambers and be found later on (June-July).

IPM Strategies:
No effective natural enemies.

Cut and destroy wilted or dead leaders by the end of June. Cut should be made below point of attack. Remove old stands of white pines around plantation.

Spray terminal leaders in late March/early April, 7-58 GDD, PPI – silver maple.

Detection of adults can be facilitated with use of a modified tedders traps (bait with ethanol and turpentine (Fig. 7).


Fig. 7

## Armillaria Root Rot (Shoestring Root Rot), *Armillaria spp.*

Hosts: All Christmas Trees

Description of Damage and Disease Cycle:
This fungus damages trees at the base directly at the root collar. Symptoms may vary. Young trees may suddenly turn yellow and then reddish-brown. Older trees may just decline over a period of years. Needles on affected trees will be shorter in length. The canopy may appear thin. Cones may be profuse but small. The most diagnostic symptoms are white fungal strands between the bark and the wood. Peeling back the bark at the base of the tree to expose the sapwood will show fungal strands. These often form fan-shaped patterns (commonly called mycelial fans) (Fig. 1). Excessive pitch may exude from affected areas. Characteristic clumps of honey-colored mushrooms may form in the fall at the base of dead trees (Fig.2).


Fig. 1


Fig. 2

The disease is spread by the growth of specialized, black, string-like strands called rhizomorphs (hence the name shoestring). These rhizomorphs will spread through the upper soil layer and attack roots directly. Armillaria can survive in the soil for decades in infected stumps and roots.

Trees under stress, especially those planted improperly are more susceptible to Armillaria. Trees planted with their roots formed into a J-shape are more susceptible.

Management Techniques:

Scouting Methods:

Look for honey-colored mushrooms at the base of dying or dead trees.

Look for declining trees.

Look for mycelial fans underneath the bark.

IPM Strategies:

When planting transplants, make sure roots are vertical in the soil and not curved into a J-shape.

Avoid planting near recently cut stumps.

Avoid planting on poor soils with poor drainage.

Maintain plant vigor.

There are no fungicide controls for this disease.

If detected on one root or one side of the root collar, expose the entire root collar area and as much of the butt as possible to the air. This will dry out the fungus. Remove all dead roots and bark.

Remove and destroy stumps and roots of infected trees.

## Fir- Fern Needle Rust, *Uredinopsis sp. and Milesina sp.*

Hosts: Balsam and white firs, potentially Fraser fir.

Alternate Host: Ferns (particularly bracken ferns)

Description of Damage and Disease Cycle:
Initial symptoms consist of yellow blotches on the upper surface of 1 year old and older needles which appear in the spring (Fig. 1). Most rust diseases of fir are characterized by orange-colored spore pustules. Fir-fern rust is the only rust affecting firs that has white spore pustules. These tube-shaped pustules can be found on the undersides of the current year's needles as well as several year old needles and are typically visible from July through August (Fig. 2 & 3). Pustules erupt and the rust spores are then dispersed to ferns. Affected needles will eventually dry up and fall from the tree.


Fig. 1


Fig. 2


Fig. 3

Bracken ferns are a preferred alternate host. Symptoms on bracken ferns include chlorosis on the upper surface of fronds between the veins. The rust pustules form on the underside of the frond.

The fungus overwinters on dead fern fronds. In spring, rust spores are disseminated via wind and rain to elongating fir needles. Symptoms do not appear the first year. Cool, moist conditions during needle elongation are required for infection.

## Management Techniques:

### Scouting Methods:

Look for white spore pustules on the undersides of needles in July and August.

### IPM Strategies:

Maintain tree vigor.

Rogue out and remove severely affected trees from the area.

Eliminate host ferns (Fig. 4) in and around plantation via mowing or an herbicide application. If ferns are only growing at the edge of the field, the only trees that require a fungicide application are the first 5 – 10 rows adjacent to the edge of the field.

Fig. 4

Fungicide applications should be made at budbreak and twice thereafter at 10 – 14 day intervals.

## Phytophthora Root Rot, *Phytophthora cinnamomi and Phytophthora sp.*

Hosts: Fraser fir (*Phytophthora cinnamomi*); other species may infect fir and spruce.

Description of Damage and Disease Cycle:
This root rot is most commonly associated with Fraser fir, but can affect other Christmas tree species. The soil borne watermold is uncommon in NYS, but since *Phytophthora cinnamomi* also affects hundreds of other species of plants it is included in this manual. *Phytophthora cinnamomi* requires warm, wet soil and is generally intolerant of temperatures below freezing. There are other species of *Phytophthora* however, which are cold tolerant that may affect conifers.

Above ground symptoms include yellowing needles, wilting and or stunting of Growth; needles quickly turn a cinnamon-brown color (Fig. 1). Affected roots appear rotted, discolored, soft and lack white growing tips. Cutting into the bark of the root collar region can expose reddish-brown streaks (Fig. 2). This disease usually starts on one side of the tree, since it affects roots and then expands toward the trunk. Phytophthora is an opportunistic pathogen which will affect trees under stress. It usually enters a plant through root wounds. It most commonly favors younger plants and can be found in transplant beds (Fig. 3). This pathogen plugs up the vascular system of the plant and prevents the transport of water and nutrients (Fig. 3). Symptoms may not show up immediately.


Fig. 1


Fig. 2

Fig. 3

Management Techniques:

Scouting Methods:

Prevention is key. Inspect transplants before planting. Do not plant transplants and/or young plants that exhibit root decay symptoms.

IPM Strategies:

Fraser fir should only be planted in fields where water drains quickly down through the soil and also quickly off the field.

Do not plant or replant Fraser fir in poorly drained, wet soils.

Fungicides can be applied as soil drenches.

## Rhabdocline, *Rhabdocline* spp.

Hosts: Douglas fir

Description of Damage and Disease Cycle:

Early spring: Reddish-brown needles on last year's growth (Fig. 1). Some needles may have a banded appearance. This banding will be visible on both the upper and lower surface of the needle. Look at the base of the tree as this is where the disease usually starts (Fig.2 ). At about the time budbreak occurs these bands on the lower surface of the needle become raised blister-like structures which will rupture and disseminate spores to newly expanding buds (Fig. 3).

Fig. 1

Fig. 2

Fig. 3

Autumn: Yellow spots or bands will appear on the current season's growth. Severely affected trees will cast last year's growth.

## Management Techniques:

### Scouting Methods:

Rogue out severely affected trees before May 1st.

### IPM Strategies:

This disease is promoted by humid, moist weather.

Trees 5+ years old or more are usually affected.

Area around base of trees should be kept weed free to increase air circulation. If possible plant on slopes.

Shear healthy trees first to avoid contamination with spores.

Shuswap variety is said to show resistance.

Lincoln strains and Rocky Mountain seed strains are very susceptible to this disease.

Apply appropriate fungicide before new growth is ½" long and make additional applications at three to four week intervals until July 1st.

## Rhizosphaera Needlecast, *Rhizosphaera kalkhoffi*

Hosts: Colorado blue spruce, occasionally white spruce

Description of Damage and Disease Cycle:
Late Fall or Early Spring: reddish/brown/purplish needles on last year's growth. Tiny black fruiting bodies (a hand lens may be necessary to see the fruiting bodies) are visible in the stomata (pore openings) of the needles (Fig. 1). Lower branches may be affected first (Fig. 2).


Fig. 1


Fig. 2

Mid-Summer: casting of the previous year's needles (Fig. 3).


Fig. 3

## Management Techniques:

### Scouting Methods:

Look for reddish/brown needles in areas where older needles have dropped from the branches especially on the bottom of the tree.

### IPM Strategies:

Plant sanitation. Drought stressed trees are more susceptible.

Keep bases of trees weed-free to promote good air circulation.

Where feasible, prune out affected branches. Remove severely affected trees and discard as this fungus can mature on cut branches. Do not prune when foliage is wet.

Fungicide applications should be made when new needles are half elongated and again when fully elongated.

## Sirococcus Twig Blight, *Sirococcus sp.*

Hosts: Colorado blue and white spruce, Douglas fir

Description of Damage and Disease Cycle:

Sirococcus twig blight affects the current season's growth and on occasion one-year old twigs. A characteristic symptom of this disease is a wilting or drooping and die-back of twig tips (shepherd's crook appearance). Infected tips turn brown (Fig. 1). Black fruiting bodies (pycnidia) are visible on the base of infected needles as well as dead shoots (Fig. 2). The damage is visible in mid to late summer and early fall. The fungus overwinters in dead, infected twig tips and cone scales. Spores (conidia) are spread to newly emerging shoots by rain or wind in spring. Young seedlings and trees are usually more susceptible, but trees of any age may be affected. Colorado blue spruce is especially susceptible. The fungus rarely kills trees, but can disfigure the tree and affect marketability.

Fig. 1

Fig. 2

Symptoms may appear sporadically throughout the tree and they may be more evident on the lower portion of the tree, as lower light levels favor infection. Sirococcus twig blight is exacerbated by cool, wet spring conditions in which needles remain wet for up to 24 hours. Most new infections occur close to the original site of infection. Long distance spore dispersal usually is through movement of infested seed or planting stock. Infections occur where conidia are deposited on or near the base of needles on new shoots. As the new shoot elongates, the side that is infected ceases growth, which causes the shoot to grow crooked. This drooping or shepherd's crook is most evident from June through August. Symptoms may show up starting two weeks after infection and will continue at least 4-6 weeks or even longer if conditions are right. Fruiting bodies usually do not appear until the following spring, ready to start the cycle all over again.

## Management Techniques:

### Scouting Methods:

Look for drooping twig tips.

Look for black fruiting bodies on dead twigs, at the base of dead needles and cone scales.

### IPM Strategies:

Carefully inspect new transplants.

Maintain tree vigor through proper cultural techniques such as weed control and plant sanitation.

Rogue and destroy severely affected trees.

Prune affected twigs when bark is dry. Disinfest tools between cuts with a bleach solution (1 part bleach to 9 parts water) or alcohol.

Apply a registered fungicide before new shoot growth is ½" long and spray twice thereafter at three to four week intervals. Thorough coverage is important.

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## Spruce Canker, also known as Cytospora Canker, *Leucostoma kunzei*

Hosts: Spruce, especially Colorado blue and Norway. Occasionally firs.

Description of Damage and Disease Cycle: This disease often affects mature trees that are stressed due to drought, winter injury, insects, other diseases or abiotic disorders. It usually affects lower branches first and then moves up in the tree. The first symptom is usually a "flagging" or dieback of an entire lower branch (Fig. 1). Needles generally turn a purplish brown color. Dead needles may cling to the branch for up to a year before dropping off, leaving the branch bare. Pitch will exude from canker sites on affected branches (Fig. 2). The pitch will drop to lower branches and become dry and crusty. The disease can occur any time throughout the year. Microscopic fruiting bodies are usually found in the surface layer of bark at the canker site or on a dead branch. Spores are readily spread by wind driven rain during wet weather and can also be carried by insects to new hosts.

Fig. 1

Fig. 2

Management Techniques:

Scouting Methods: Look for flagged (dead) branches on the lower portion of mature trees. Look for excessive pitch on affected branches.

IPM Strategies:
Remove affected branches and destroy. Do not prune or shear infected trees during wet weather. Disinfect pruning shears between cuts with a solution of 7 parts denatured alcohol and 3 parts water between cuts. Avoid wounding.

Keep trees lightly fertilized to improve plant vigor. Fertilize in the spring.

## Swiss Needlecast, *Phaeocryptopus gaumannii*

Hosts: Douglas fir

Description of Damage and Disease Cycle:
Infection occurs at budbreak and as needles are elongating in the spring. Spores are delivered via wind and rain. At this time of year tiny fuzzy black fruiting bodies can be seen on the undersides of newly expanding needles as well as older needles (Fig. 1). They appear to be lined up on either side of the midrib of the needle. This is the only positive diagnostic symptom which provides a definitive diagnosis of the disease. One of the first signs is a premature yellowing of one year old needles (Fig. 2). Two year old needles will brown. Needles usually brown completely before falling off the tree (Fig. 3). Infection typically starts on lower branches and it may take three to four years for affected needles to be cast from the tree. Growth may be thin and only the current year's needles may be attached to the twigs.


Fig. 1


Fig. 2


Fig. 3

Management Techniques:

Scouting Methods:

In early spring look at the undersides of one year old needles on lower branches to check for the presence of fruiting bodies.

Check for yellow and or brown needles on growth two years old or more.

IPM Strategies:

Do not shear infected trees during wet weather. Prune healthy trees first. Sterilize tools with alcohol when used on infected trees.

Apply a fungicide when new shoots are ½ inch long. Make additional applications at three to four week intervals until July 1st.

## Weir's Cushion Rust, *Chrysomyxa weirii*

Hosts: Colorado blue spruce, black, white, Serbian and occasionally Norway spruce.

Alternate Host: none – repeated cycles of infection on spruce.

Description of Damage and Disease Cycle:
Early Spring: Yellow spots on needles of the previous year's growth. By mid-spring, these yellow spots begin to develop golden-yellow to orange pustules (Fig. 1). These pustules rupture and disseminate spores to newly expanding needles. Yellow spots or bands will start to appear on the current year's needles by midsummer (Fig. 2). Infected needles will drop from the tree by autumn (Fig. 3).


Fig. 1


Fig. 2

Fig. 3

Management Techniques:

Scouting Methods:
In spring, look for yellow-orange spots or pustules on last year's needles.

Look for yellow spots or banding on current season's needles by mid-summer.

IPM Strategies:
Rogue out severely affected trees.

To protect trees not yet affected, apply a fungicide when 10 percent of the tree is in bud break, and make two more applications at 7 – 10 day intervals.

## Drought Injury

Hosts: All Christmas Trees

Description of Damage:
Drought damage may not show up for a year or more and the effect may be cumulative. The most common sign of drought is a dying of branches starting at the top of the tree (Fig.1). Twig tips of current year's growth may wilt or droop. Tips may initially remain green and eventually brown (Fig. 2). Cumulative effects of drought may yield short needles and sparse or thin crown. Trees weakened by drought are susceptible to invasion by secondary insects and/or diseases. These are sometimes referred to as secondary pests which are opportunistic and under normal circumstances would not affect a healthy tree. Armillaria root rot and bark beetles are examples of opportunistic invaders.


Fig. 1


Fig. 2

Management Techniques:

IPM Strategies:

Reduce competition from weeds.

When feasible provide irrigation, especially to newly planted transplants.

Do not plant shallow-rooted species such as true firs and spruce in sandy soils.

## Fall Needle Drop

Hosts: All Christmas Trees

Description of Damage:
Older needles, especially on the interior of the tree turn yellow and shed. This is a normal phenomenon. Lower light in the interior of the tree as well as physiological stress will cause these older needles to die. It is often most pronounced in late summer and fall. Needles usually yellow before they drop off (Figs. 1, 2). This fall needle drop is most often seen on white pines (Fig. 3).


Fig. 1


Fig. 2


Fig. 3

## Management Techniques:

### IPM Strategies:

Cultural practices to maintain tree vigor and health may help to reduce large quantities of fall needle drop.

## Frost Damage

Hosts: True firs, Douglas fir, spruce

Description of Damage:
Late spring frosts (when temperatures go below freezing) as buds are breaking or new tender growth is elongating can kill tender opening buds (Fig. 1) and elongating shoots. Buds and shoot tips may droop, turn tan, then brown and die (Figs. 2, 3, 4, 5, 6). New shoots usually develop next to the dead ones. Damage will normally appear a few days after cold temperatures.

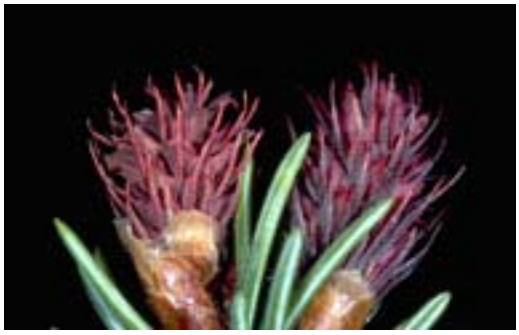
Fig. 1


Fig. 2


Fig. 3


Fig. 4


Fig. 5


Fig. 6

## Management Techniques:

### IPM Strategies:

Varieties that tend to break bud early are more susceptible.

Remove dead shoots.

Avoid planting susceptible trees in low-lying areas that may serve as “frost pockets”.

## Winter Injury

Hosts: All Christmas Trees

Description of Damage:
In late winter and early spring look for needles to turn reddish-brown especially on the south or west side of the tree (Fig. 1). Branches or the entire tree may be affected. Buds are usually not affected and should continue to develop normally.


Fig. 1

In late winter and early spring on sunny days daytime temperatures begin to rise which may break dormancy. Transpiration is a biological process which causes moisture to evaporate from plant tissue, in this case the needles. During the growing season, roots absorb moisture and this moisture is expended from the needles. In winter and early spring, moisture in the ground is frozen and therefore roots cannot absorb it. On mild, sunny days needles will lose moisture (transpire) and it cannot be replaced. The result is needle browning and death. A rapid rise in daytime temperatures followed by a rapid decrease in temperatures at night causes moisture in the needles to freeze and the result is tissue death. Winter injury will often begin above the snowline (Fig. 2). Branches below the snowline are insulated and protected from rising temperatures. Though the damage occurs in late winter or early spring, symptoms may not show up until later in the spring.


Fig. 2

## Management Techniques:

### IPM Strategies:

First look for symptoms on the south or west side of the tree or above the snowline. If the entire tree is turning reddish-brown it may be signs of a disease or drought stress.

Winter injury usually cannot be prevented. Mulching around the base of the tree will reduce frost heaving. Cultural practices to maintain tree vigor and health may help to alleviate winter injury.

**White-Tailed Deer**

Hosts: True firs (Fraser and Balsam are most susceptible to damage) and Douglas fir. Scots, Austrian, Norway spruce, white spruce and red pines are less susceptible to severe to damage. Colorado blue spruce is rarely damaged.

Description of Damage:
Deer will feed on tender young shoots of many Christmas tree species. Feeding damage will occur throughout the year, but is usually most severe in late winter and early spring because other food sources are scarce. Deer do not have upper teeth and therefore leave a ragged tear in plant tissue. Deer will feed to approximately six feet in height (Fig. 1 & 2). In addition, they will rub their antlers against the bark of young trees (especially the more aromatic conifers) causing branches to dieback (Figs. 3 & 4).


Fig. 1


Fig. 2


Fig. 3


Fig. 4

## Management Techniques:

### IPM Strategies:

#### Fencing:

Woven wire fences are the best choice for excluding deer. Fences should be at least eight feet high. If the height is to be increased to ten feet, the last two feet can be smooth wire. Fencing may not work if the area to be protected is greater than 5 acres.

Functional, secure gates must be used with any type of fencing. Gates should be closed upon entering or leaving the area. An alternative to opening and closing the gates at each entry and exit is to install double cattle guards at the gate entrance. Cattle guards are grates that are installed at the ground level. Deer will not cross double cattle guards.

High-tensile multiple stranded is an alternative many growers use. A seven strand vertical design with the first strand being eight inches above the ground is recommended for large areas (Fig. 5). A slanted electrical fence (Fig. 6) gives depth perception (deer do not have good depth perception) and is more effective than vertical designs.

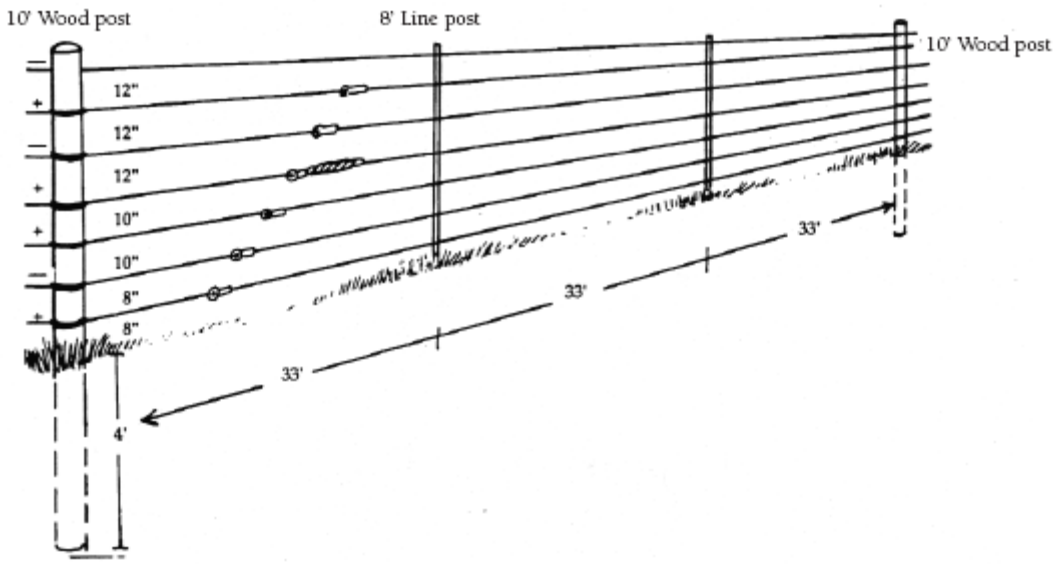


Fig. 5

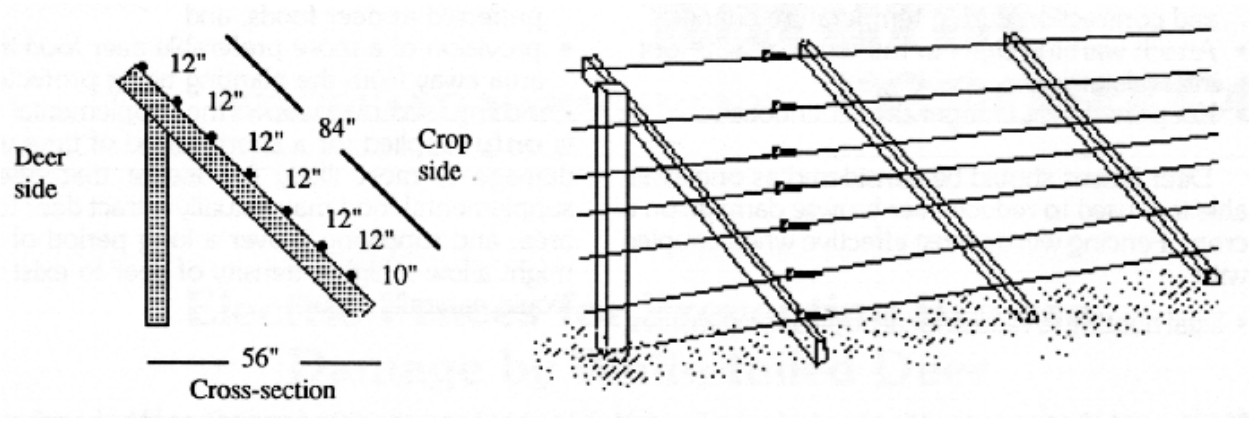


Fig. 6

Repellents:

Repellents are either odor or taste based and vary greatly in their effectiveness. Research at Cornell has shown that odor-based repellents usually outperform taste based repellents.

Repellents should be applied at the first sign of feeding damage to prevent development of a feeding pattern.

Newly planted trees must be thoroughly covered with repellent.

Taller and older trees must have their branch terminals covered from the ground up to a height of about six feet.

New growth that appears after an application will need a new repellent application. Application should be made when there is no prediction of precipitation for 24 hours.

Repellents should be applied when air temperatures are between 40˚ and 80˚F. and will remain in that range for 24 hours.

When deer browsing pressure is high, repellents may have to be reapplied every five weeks.

# Meadow Vole (*Microtus pennsylvanicus*)/Pine Vole (*Microtus pinetorum*) Damage

Hosts: All Christmas Trees

Description of Damage:
Meadow voles (meadow mice) can girdle the bark at the base of trees by their feeding. Pine voles damage trees by feeding on the roots. Voles are small rodents with small tails and short legs. The meadow vole is more abundant in NYS than the pine vole. The pine vole however is very common in the Hudson Valley. The meadow vole is dark brown and 5 to 7.5 inches long with a tail that is more than twice the length of its hind foot. The pine vole is auburn colored and 3.5 to 5 inches in length with short legs and a short tail. Its tail is shorter than its hind legs (Fig. 1).

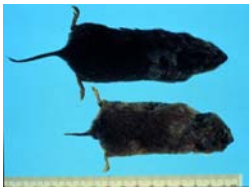
Fig. 1

During the growing season, meadow and pine voles feed mainly on herbaceous material. When the food supply diminishes, they will turn to tree bark for sustenance.

Meadow moles spend most of their time above ground and utilize surface trails through leaf litter and grasses. Their burrows are about one inch in diameter, and two to four inches deep. Pine voles can be found in underground burrows in a trail system one to two feet deep. These burrows will open to the soil surface and connect to above ground runways (Fig. 2).


Fig. 2

Both meadow and pine voles have very high metabolism thus necessitating the need to constantly seek food. They are active during the day and during the winter months will travel under the snow cover.

Damage by meadow and pine voles may go undetected until the snow melts in the spring when girdling is visible. Meadow voles usually girdle trees at the ground level, while pine voles usually girdle roots and their damage may be more difficult to identify (Fig. 3).


Fig. 3

Vole damage is identified by irregular patches 1/8” wide by 3/8” long and 1/16” deep or more. Tooth-marks are often angled in the same direction (Fig. 4). Rabbits that also gnaw at tree bark may cause damage up to 20” high along the trunk.

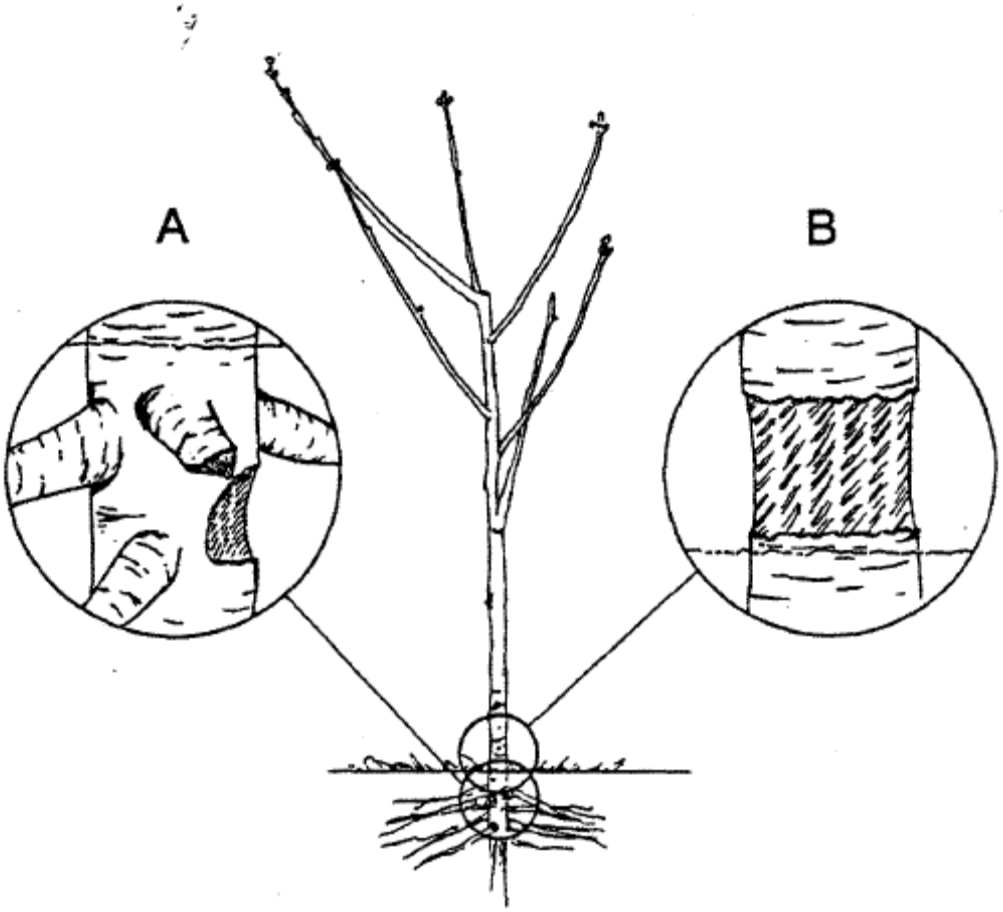


*Fig. 2. A. Damage below the ground indicates pine vole activity; B. Damage above the ground indicates meadow vole activity.*

Fig. 4

## Management Techniques:

### IPM Strategies:

Place snap-back mouse traps baited with apples on active vole runways. Cover traps to increase capture success, as voles prefer areas with overhead protection. Trapping is best achieved in the fall before snowfall accumulates.

Keep ground cover and leaf litter to a minimum. Keep grass mowed close to the ground. Mulch or leaf litter around the base of trees has been shown to increase vole populations. Keeping the base of trees as bare as possible will help to reduce the vole feeding.

For a list of registered materials please check the *Cornell Pest Management Guide for Commercial Production and Maintenance of Trees and Shrubs*. This annual publication can also be viewed online at http://ipmguidelines.org/treesandshrubs. Baits are most effective when applied in the fall prior to snowfall. There are commercial bait stations available to prevent non-target animals from consuming the toxicant.

# CHRISTMAS TREE WEB RESOURCES

**Please Note: Web addresses change. If any of the web addresses listed here do not work, simply use a search engine and type in the resource. The current web address should appear is the website is still active.**

**This resource list is not listed in any order of preference.**

**List of different Christmas tree associations throughout the US**
http://www4.ncsu.edu/unity/users/f/frampton/www/christmas%20tree%20links/christmas_tree_association_sites.htm

**Cornell Christmas Tree IPM Page**
http://ppathw3.cals.cornell.edu/Trees/TreePests.html

**Cornell Cooperative Extension Clinton County Christmas Tree Information**
http://www.cce.cornell.edu/clinton/ag/forestry/xmastree.html

**National Christmas Tree Growers Association**
http://www.christmastree.org/home.cfm

**Christmas Tree Farmers Association of New York**
http://www.christmastreesny.org/

**New Hampshire-Vermont Christmas Tree Association**
www.nh-vtchristmastree.org/

**California Christmas Tree Association- Resources**
http://www.cachristmas.com/research.htm

**Connecticut. Christmas Tree Growers Association**
http://www.ctchristmastree.org/

**New Jersey Christmas Tree Growers' Association**
http://www.njchristmastrees.org/

**North Carolina Christmas Tree Association**
http://www.ncchristmastrees.com/

**Northwest Christmas Tree Growers Association**
http://www.nwtrees.com/

**Pennsylvania Christmas Tree Growers Association**
http://www.christmastrees.org/

**University of Nebraska Christmas Tree Production Guide**
http://ianrpubs.unl.edu/forestry/ec1741.htm

**Penn State Christmas Tree Home Page**
http://ctrees.cas.psu.edu/

02/07

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Johnson, Warren T. and Howard H. Lyon. 1991. Insects that Feed on Trees and Shrubs. Cornell University Press. Ithaca, NY.

Pedigo, Larry P. 1999. Entomology and Pest Management, Third Edition. Prentice Hall, NJ.

Pennsylvania State University. 2006. Christmas Tree Management Reference Guide. State College, PA.

Sinclair, Wayne A., Howard H. Lyon and Warren T. Johnson. 1993. Diseases of Trees and Shrubs. Cornell University Press. Ithaca, NY.

Sidebottom, Jill R., Jeff Owen and Doug Hundley. 2002. Scouting Fraser Fir Christmas Trees. North Carolina State University. Raleigh, NC.

## Acknowledgements

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Many people have contributed to the creation of this guide. I wish to thank the following Christmas tree farmers; Steve Abel, Gordie Bell, Randy Marz, Doug Moffitt and Bill Steidle for utilizing earlier drafts of this guide and piloting it in the field; to Rick Harper, my friend and colleague, Cornell Cooperative Extension Westchester County for your enthusiastic support of my studies and project; to Dr. Betsy Lamb, Dr. Paul Weston, Margery Daughtrey, Dr. Paul Curtis, Cornell University for reviewing the fact sheets; to Gary Couch, Cornell University for working with me to implement an IPM education program for Christmas tree farmers; to Dr. David Keith, Dr. Leon Higley, Dr. Tiffany Heng-Moss, Dr. Tom Weissling, University of Nebraska for your support of this project; to my office colleagues Nancy Halas, Cheryl Hearty, Les Hulcoop, Wendy Tremper-Wollerton, Bob Weybright, Cornell Cooperative Extension Dutchess County for encouragement and support of this project; to my fellow student Bruce Eckholm, University of Nebraska for taking the journey with me; to my friends Sue Artuz, Mary Sontheimer, Mary Kramarchyk, Lynn Smookler for being my cheerleaders; to my Dad for his love and support; to my Labs Mookie and Wilson for spending many a day and night at my feet under the dining room table; and finally and most importantly, to my husband Andy and our sons Chad and Alex for your love, support , encouragement and patience with a wife and mother who cluttered the house with all sorts of reference books and arthropods!

Stephanie Mallozzi
January 2007

# Beneficial Arthropods

Lady Beetle

Lady Beetle Larva

Lady Beetle Eggs

Twice Stabbed Lady Beetle

Lady Beetle Pupa

Robber Fly

Flower Fly

Green Lacewing Adult

Green Lacewing Larva

Green Lacewing Eggs

Praying Mantid

Praying Mantid Egg Case

Orb Weaver Spider

Ground Beetle

Predatory Mites

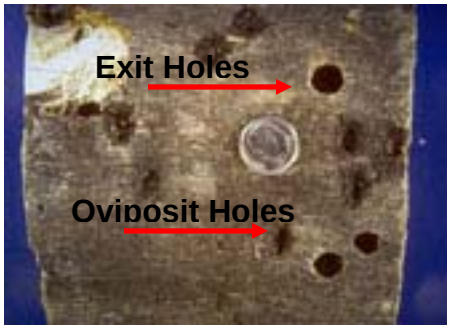
Cicada Killer Wasp

# Invasive Pests

Asian Longhorned Beetle

ALB Life Cycle

ALB Eggs




ALB Oviposit and Exit Holes

Viburnum Leaf Beetle

VLB Eggs

**VLB Larvae**

**VLB Late Instar Larvae**

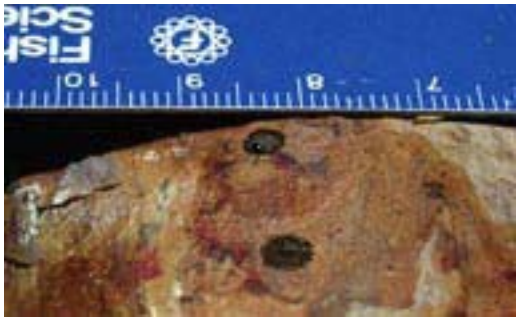
**Sirex Wood Wasp Male Adult**

**Sirex Wood Wasp Adult Female**

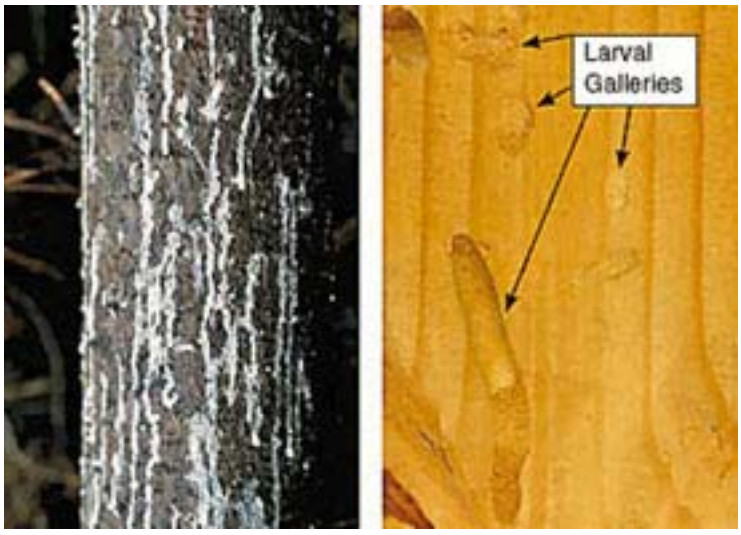
**SWW Male**

**SWW Female**

**SWW Larva Tail Spine**



**SWW Exit Holes**




**SWW Larvae Galleries with Frass**

Lily Leaf Beetle

LLB Eggs

LLB Larva

LLB Pupa

Hemlock Woolly Adelgid

HWA Eggs/Adults

Cedar Longhorned Beetle
Male and Female

CLB Larva with Frass

CLB Damage

**Brown Marmorated Stink Bug Adult**

**BMSB Nymph**

**Elongate Hemlock Scale**

**European Pine Shoot Moth**

**EPSM Pupa**

**Emerald Ash Borer**

**EAB Larvae**


**EAB Eggs**

**EAB Galleries**

**EAB Exit Holes**

**Winter Moth Male**

**Winter Moth Female**

**Winter Moth Larva**

**Winter Moth Pupa**

**European Crane Fly**

**ECF Larvae**

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Balsam Gall Midge

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Balsam Twig Aphid

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Cooley Spruce Gall Adelgid

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Douglas Fir Needle Midge

Fig. 1: USDA Forest Service Archives, USDA Forest Service, www.forestryimages.org.
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Eastern Spruce Gall Adelgid

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Elongate Hemlock Scale

Fig. 1: Eric R. Day, Virginia Polytechnic Institute and State University, www.forestryimages.org.
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Fig. 3: Eric R. Day, Virginia Polytechnic Institute and State University, www.forestryimages.org.

Eriophyid (Spruce) Spider Mites

Fig. 1: Rayanne Lehman, Pennsylvania Department of Agriculture, www.forestryimages.org.

Northern Pine Weevil

Fig. 1: Dr. Dave Shetlar, Ohio State University.
Fig. 2: B. Hanson, USDA Forest Service, www.forestryimages.org.
Fig. 3: Therese Arcand, Canadian Department of Forestry.

Pales Weevil

Fig. 1: Rayanne Lehman, Pennsylvania Department of Agriculture, www.forestryimages.org.
Fig. 2: William H. Hoffard, Entomologist, Region 8, USDA Forest Service, Asheville, NC.
Fig. 3: Rayanne Lehman, Pennsylvania Department of Agriculture, www.forestryimages.org.

Pine Needle Scale

Fig. 1: Dr. Dave Shetlar, Ohio State University.
Fig. 2: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.

Saratoga Spittlebug

Fig. 1: USDA Forest Service - Northeastern Area Archives, USDA Forest Service, www.forestryimages.org.
Fig. 2: James B. Hanson, USDA Forest Service, www.forestryimages.org.
Fig. 3: Principal insect ecologist, North Central Forest Experiment Station, Forest Service, U.S. Department of Agriculture, Michigan State University, East Lansing.
Fig. 4: USDA Forest Service - Northeastern Area Archives, USDA Forest Service, www.forestryimages.org.
Fig. 5: Principal insect ecologist, North Central Forest Experiment Station, Forest Service, U.S. Department of Agriculture, Michigan State University, East Lansing.
Fig. 6: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.

Spruce Bud Scale

Fig. 1: Steven Katovich, USDA Forest Service, www.forestryimages.org.

Spruce Budworm

Fig. 1: USDA Forest Service - Northeastern Area Archives, USDA Forest Service, www.forestryimages.org.
Fig. 2: USDA Forest Service - Northeastern Area Archives, USDA Forest Service, www.forestryimages.org.
Fig. 3: A. Steven Munson, USDA Forest Service, www.forestryimages.org.

Spruce Needleminers

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Spruce Spider Mites

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Fig. 2: Rayanne Lehman, Pennsylvania Department of Agriculture, www.forestryimages.org.
Fig. 3: USDA Forest Service - Ogden Archives, USDA Forest Service, www.forestryimages.org.
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Two-Spotted Spider Mites

Fig. 1: Whitney Cranshaw, Colorado State University, www.forestryimages.org.
Fig. 2: Rayanne Lehman, Pennsylvania Department of Agriculture, www.forestryimages.org.
Fig. 3 Paul J. Johnson, Ph.D., South Dakota State University, .
Fig. 4: David Cappaert, www.forestryimages.org.

White Pine Weevil

Fig. 1: Gibson, www.forgestryimages.org. ?
Fig. 2: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 3: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 4: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 5: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 6: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 7: Rayanne Lehman, Pennsylvania Department of Agriculture.

Armillaria Root Rot

Fig. 1: USDA Forest Service Archives, USDA Forest Service, www.forestryimages.org.
Fig. 2: USDA Forest Service - Northeastern Area Archives, USDA Forest Service, www.forestryimages.org.

Fir-Fern Needle Rust

Fig. 1: Cornell University Cooperative Extension Diagnostic Lab, NY.
Fig. 2: Cornell University Cooperative Extension Diagnostic Lab, NY.
Fig. 3: Cornell University Cooperative Extension Diagnostic Lab, NY.

Phytophthora Root Rot

Fig. 1: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 2: Larry Grand, http://www.cals.ncsu.edu/
Fig. 3: USDA Forest Service Archives, USDA Forest Service, www.forestryimages.org.

Rhabdocline Needlecast

Fig. 1: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 2: Cornell University Cooperative Extension Diagnostic Lab, NY.
Fig. 3: John W. Schwandt, USDA Forest Service, www.forestryimages.org.

Rhizosphaera Needlecast

Fig. 1: Minnesota Department of Natural Resources Archives, Minnesota Department of Natural Resources, www.forestryimages.org.
Fig. 2: Minnesota Department of Natural Resources Archives, Minnesota Department of Natural Resources, www.forestryimages.org.
Fig. 3: http://www.extension.iastate.edu/Pages/plantpath/clinic/Rhizosphaera/.

Sirococcus Twig Blight

Fig. 1: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 2: Janna Beckerman, University of Minnesota, www.forestryimages.org. ?

Spruce (Leucostoma) Canker

Fig. 1: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 2: Jana Albers, Minnesota Department of Forestry, www.forestryimages.org. ?

Swiss Needlecast

Fig. 1: USDA Forest Service Archives, USDA Forest Service, www.forestryimages.org.
Fig. 2: USDA Forest Service, North Central Research Station Archives, www.forestryimages.org.
Fig. 3: USDA Forest Service Archives, USDA Forest Service, www.forestryimages.org.

Weir's Cushion Rust

Fig. 1: Cornell Cooperative Extension Diagnostic Lab, NY.
Fig. 2: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 3: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.

Drought Injury

Fig. 1: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 2: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.

Fall Needle Drop

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Fig. 3: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.

Frost Injury

Fig. 1: Robert Anderson, USDA Forest Service, www.forestryimages.org.
Fig. 2: Dave Powell, USDA Forest Service, www.forestryimages.org.
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Fig. 4: Robert L. Anderson, USDA Forest Service, www.forestryimages.org.
Fig. 5: Minnesota Department of Natural Resources, Minnesota Department of Agriculture www.forestryimages.org.
Fig. 6: Petr Kapitola, Forestry and Game Management Research Institute, Chechia.

Winter Injury/Burn

Fig. 1: Steven Katovitch, USDA Forest Service, www.forestryimages.org.
Fig. 2: USDA Forest Service Archives, USDA Forest Service, www.forestryimages.org.

Deer Damage

Fig. 1: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
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Fig. 3: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 4: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Fig. 5: Paul Curtis and Kristi L. Sullivan, White-Tailed Deer, Wildlife Management Fact Series, Cornell Cooperative Extension, Ithaca, NY
Fig. 6: Paul Curtis and Kristi L. Sullivan, White-Tailed Deer, Wildlife Management Fact Series, Cornell Cooperative Extension, Ithaca, NY

Meadow/Pine Vole Damage

Fig. 1: USDA Forest Service, North Central Research Station Archives, www.forestryimages.org.
Fig. 2: Mead Voles and Pine Voles, UCONN IPM Program, http://www.canr.uconn.edu/ces/ipm/homegrnd/htms/volepics.htm.

Beneficial Arthropods

Lady Beetle: Whitney Cranshaw, Colorado State University, www.forestryimages.org.
Lady Beetle Larva: Clemson University - USDA Cooperative Extension Slide Series, www.forestryimages.org.
Lady Beetle Eggs: Alton N. Sparks, Jr., University of Georgia, www.forestryimages.org.
Twice Stabbed Lady Beetle: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Lady Beetle Pupa: James Solomon, USDA Forest Service, www.forestryimages.org.
Robber Fly: David Cappaert, www.forestryimages.org.
Flower Fly: Stephanie D. Mallozzi, Cornell Cooperative Extension Dutchess County, NY.
Green Lacewing Adult: Joseph Berger, www.forestryimages.org.
Green Lacewing Larva: Whitney Cranshaw, Colorado State University, www.forestryimages.org.
Green Lacewing Eggs: Herbert A. "Joe" Pase III, Texas Forest Service, www.forestryimages.org.
Praying Mantid: David Cappaert, , www.forestryimages.org.
Praying Mantid Egg Case: Dave Shetlar, Ohio State University.
Orb Weaver Spider: Dave Shetlar, Ohio State University.
Ground Beetle: ground beetle Joseph Berger, www.forestryimages.org.
Predatory Mites: Dave Shetlar, Ohio State University.
Cicada Killer Wasp: Nancy Hinkle, University of Georgia, www.forestryimages.org.

Invasive Pests:

Asian Longhorned Beetle Male: Michael Bohne, USDA Forest Service, www.forestryimages.org.
ALB Female: Michael Bohne, USDA Forest Service, www.forestryimages.org.

ALB Life Cycle: Kenneth R. Law, USDA APHIS PPQ, www.forestryimages.org.
ALB Eggs: Larry R. Barber, USDA Forest Service, www.forestryimages.org.
ALB Oviposit and Exit Holes: E. Richard Hoebeke, Cornell University, www.forestryimages.org.
Viburnum Leaf Beetle: Paul Weston, Cornell University, www.forestryimages.org.
VLB Eggs: Paul Weston, Cornell University, www.forestryimages.org.
VLB Larvae: Paul Weston, Cornell University, www.forestryimages.org.
VLB Late Instar Larvae: Paul Weston, Cornell University, www.forestryimages.org.
Sirex Wood Wasp Male Adult: Dennis A. Haugen, USDA Forest Service, Kent Loeffler, Cornell University.
Sirex Wood Wasp Adult Female: Dennis A. Haugen, USDA Forest Service, Kent Loeffler, Cornell University.
SWW Male: William M. Ciesla, Forest Health Management International, www.forestryimages.org.
SWW Female: David R. Lance, USDA APHIS PPQ, www.forestryimages.org.
SWW Tail Spine: Dennis A. Haugen, USDA Forest Service, Kent Loeffler, Cornell University.
SWW Exit Holes: David R. Lance, USDA APHIS PPQ, www.forestryimages.org.
SWW Larvae Galleries with Frass: Dennis A. Haugen, USDA Forest Service, Kent Loeffler, Cornell University.
SWW Pitch From Oviposition Wounds: Dennis Haugen, www.forestryimages.org.
Lily Leaf Beetle: Lisa Tewksbury, University of Rhode Island, www.forestryimages.org.
LLB Eggs: Richard A. Casagrande, University of Rhode Island, www.forestryimages.org.
LLB Larva: Richard A. Casagrande, University of Rhode Island, www.forestryimages.org.
LLB Pupa: Richard A. Casagrande, University of Rhode Island, www.forestryimages.org.
Hemlock Woolly Adelgid: William M. Ciesla, Forest Health Management International, www.forestryimages.org.
HWA Eggs/Adults: Michael Montgomery, USDA Forest Service, www.forestryimages.org.
Japanese Cedar Longhorned Beetle Male and Female: Connecticut Agricultural Experiment Station Archives, Connecticut Agricultural Experiment Station, www.forestryimages.org.
JCLB Larva with Frass: Connecticut Agricultural Experiment Station Archives, Connecticut Agricultural Experiment Station, www.forestryimages.org.
JCLB Damage: Connecticut Agricultural Experiment Station Archives, Connecticut Agricultural Experiment Station, www.forestryimages.org.
Brown Marmorated Stink Bug Adult: David R. Lance, USDA APHIS PPQ, www.forestryimages.org.
BMSB Nymph: David R. Lance, USDA APHIS PPQ, www.forestryimages.org.
BMSB Eggs: David R. Lance, USDA APHIS PPQ, www.forestryimages.org.
Elongate Hemlock Scale: Eric R. Day, Virginia Polytechnic Institute and State University, www.forestryimages.org.

Emerald Ash Borer: David Cappaert, www.forestryimages.org.
EAB Larva: David Cappaert, Michigan State University
EAB Eggs: David Cappaert, www.forestryimages.org.
EAB Galleries: Joseph O'Brien, USDA Forest Service, www.forestryimages.org.
EAB Exit Holes: Joseph O'Brien, USDA Forest Service, www.forestryimages.org
Winter Moth Male: Louis-Michel Nageleisen, Département de la Santé des Forêts, www.forestryimages.org.
Winter Moth Female: Hannes Lemme, , www.forestryimages.org.
Winter Moth Larva: Louis-Michel Nageleisen, Département de la Santé des Forêts, www.forestryimages.org.
Winter Moth Pupa: Hannes Lemme, , www.forestryimages.org.
European Crane Fly Adult: Joe Ogrodnick, Cornell University.
ECF Larvae: Daniel Peck, Cornell University.

# Christmas Tree IPM Scouting Report

Grower _____ Date _____ Field _____ Scout _____

| Tree Type | Pest | #Plants Examined | #Plants Detected | Comments |
|---|---|---|---|---|
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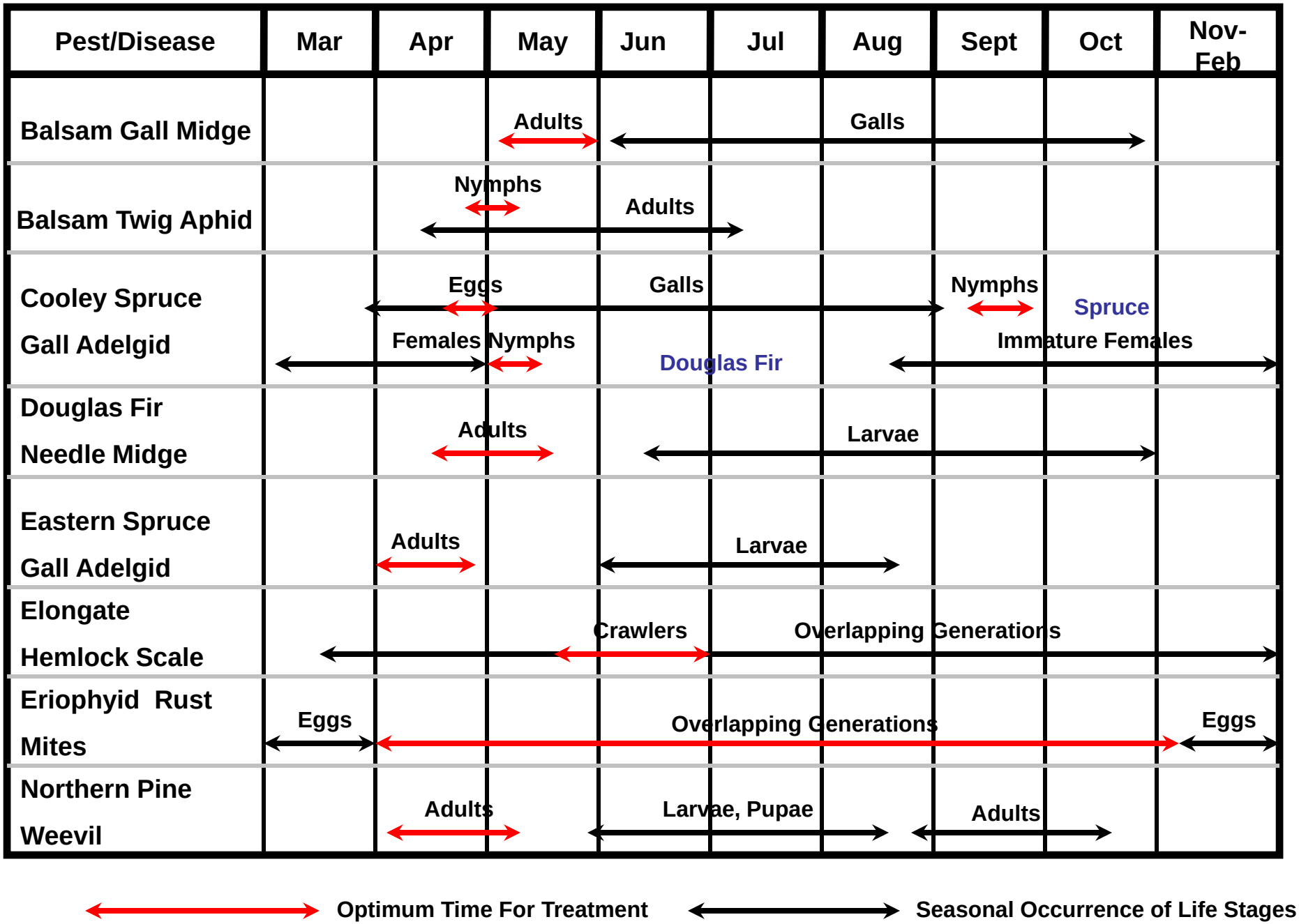
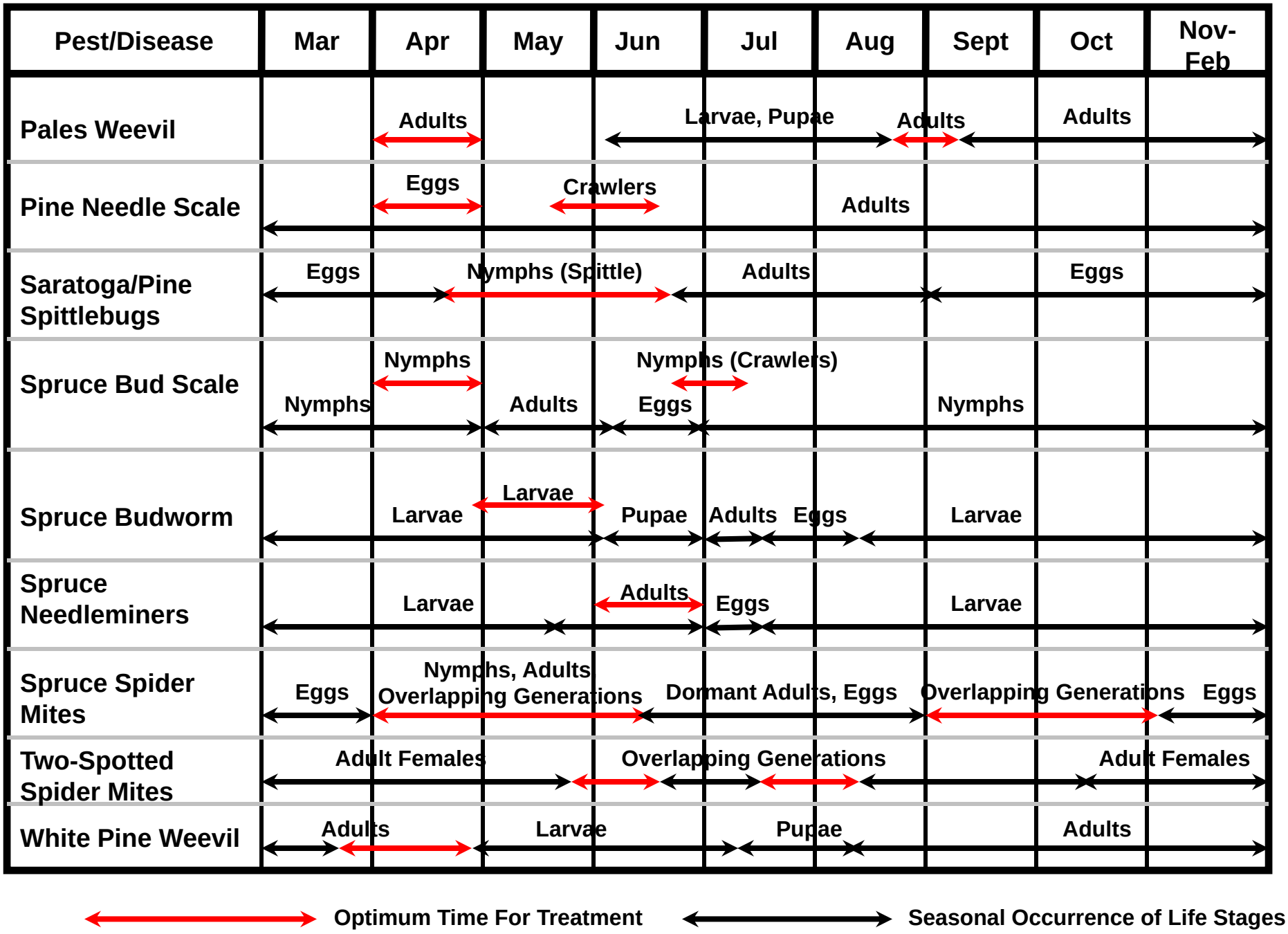

Pest/Disease
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov-Feb
Balsam Gall Midge
Adults
Galls
Balsam Twig Aphid
Nymphs
Adults
Cooley Spruce Gall Adelgid
Eggs
Galls
Nymphs
Spruce
Females
Nymphs
Douglas Fir
Immature Females
Douglas Fir Needle Midge
Adults
Larvae
Eastern Spruce Gall Adelgid
Adults
Larvae
Elongate Hemlock Scale
Crawlers
Overlapping Generations
Eriophyid Rust Mites
Eggs
Overlapping Generations
Eggs
Northern Pine Weevil
Adults
Larvae, Pupae
Adults
Optimum Time For Treatment
Seasonal Occurrence of Life Stages


Pest/Disease
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov-Feb
Pales Weevil
Adults
Larvae, Pupae
Adults
Adults
Pine Needle Scale
Eggs
Crawlers
Adults
Saratoga/Pine Spittlebugs
Eggs
Nymphs (Spittle)
Adults
Eggs
Spruce Bud Scale
Nymphs
Nymphs (Crawlers)
Nymphs
Adults
Eggs
Nymphs
Spruce Budworm
Larvae
Larvae
Pupae
Adults
Eggs
Larvae
Spruce Needleminers
Adults
Larvae
Eggs
Larvae
Spruce Spider Mites
Nymphs, Adults
Eggs
Overlapping Generations
Dormant Adults, Eggs
Overlapping Generations
Eggs
Two-Spotted Spider Mites
Adult Females
Overlapping Generations
Adult Females
White Pine Weevil
Adults
Larvae
Pupae
Adults
Optimum Time For Treatment
Seasonal Occurrence of Life Stages