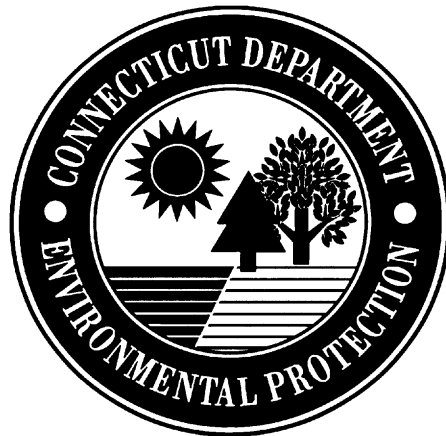


Study Manual for Private Applicator Certification

Christmas Tree



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## Preface

Any person who uses restricted-use pesticides must be licensed in order to be able to purchase such products. **Licensing is not required if only general-use pesticides are used, with the exception of commercial applications.**

Any person who sprays another's property in exchange for money must possess a commercial applicator's license. However, individuals that are licensed as a private applicator can spray another's property in exchange for services. (i.e.; he might trade a spray job in the spring for help with harvest in the fall)

A farmer wishing to use restricted-use pesticides would apply for a "private applicator's license." The private applicator may then buy and apply restricted-use pesticides on their own farm, property they rent or on the farms of others, provided that they do not get paid to do so.

It is not necessary for the licensed private applicator to actually perform all pesticide applications. An employee or family member can apply pesticides, however, the license holder is responsible for training the person who actually does the work, and must be available if needed.

Private applicators are required to maintain records with respect to each use of restricted-use pesticide and must file a report of their usage on or before January thirty-first each year for the previous year's applications.

This booklet was prepared as a study guide for those individuals seeking certification as private applicators in Connecticut. It contains brief descriptions of the major pests of each crop, their life cycles and the damage they cause to the host plants.

As a minimum requirement for certification, a private applicator must show that they possess a practical knowledge of laws pertaining to pesticide applications and the pest problems associated with their farming operation. This practical knowledge includes ability to recognize common pests and damage caused by them. Recognition is critical because it is the first step in control. The private applicator must be able to recognize the pest problem before they select among the available pesticides.

This booklet is not to be considered a complete source of information. Information on integrated pest management (IPM) and suggested spray schedules may be obtained from the Connecticut Cooperative Extension Service or Connecticut Agricultural Experiment Station.

# Insects

## Scale Insects

### Description

Scale insects constitute a very large group of plant-feeders. They occur on shade and ornamental trees, shrubs, flowers and greenhouse use plants. They have sucking mouthparts and feed on plant juices. Scales generally are quite small and occasionally become so numerous that they coat the leaves and stems. Scale insects are widely disseminated through the movement of infested nursery stock. They are divided into two groups for convenience: hard scales and soft scales (ex: Tulip tree Scale)

**Hard Scales** - (ex: Oyster shell Scale) These insects secrete a waxy, hardened, protective covering which is not attached to the insect's body. This protective covering, under which the insect lives and feeds, is called the scale or armor. The tiny scale may be circular, semi-circular, oblong or pear-shaped. They do not have eyes, legs or antennae. Adult females are wingless. The adult males are tiny, two-winged gnat-like insects.

**Soft Scales** - (ex: Fletcher Scale) The outer scale covering on soft scales is fused to the body of the insect and cannot be separated.

### Life Cycle

In both groups, eggs or living young are deposited under the female scale. During part of the nymphal period the scales move about on the plant. This period is usually referred to as the crawler stage. Once the crawlers insert their mouthparts into the plant they cannot move again. The males, however, are an exception; on reaching maturity they develop wings and fly in search of females.

### Damage

Scales damage plants by sucking the plant juices from the leaves and stems causing dead areas to appear on the leaves. In addition, soft scales excrete honeydew which may collect in great quantities on the stems and leaves. A black sooty fungus develops on the honeydew. If left uncontrolled, defoliation may occur and the plants die.

## **Elongate Hemlock Scale (*Fiorinia externa*)**

### Description

Adult females are soft bodied, legless, wingless and are enclosed in an elongate cover that is light yellow to brown, translucent and about 1/8 inch long. The adult male cover is elongate, white and slightly smaller than the female. The adult males are tiny, two-winged gnat-like insects and are feeble flyers. The cloud of males flying around a tree

can sometimes identify these as being heavily infested. Crawlers are six-legged first stage nymphs that hatch from translucent eggs underneath the female cover. They are soft bodied, lemon-colored and about one tenth the size of the female. The second-stage nymphs are sedentary, soft bodied and enclosed in an amber colored cover, ranging in size up to 1/32 inch. Elongate hemlock scale and cryptomeria scales somehow are able to insert themselves under the cuticle on the underside of the needles. This thin additional layer of plant tissue may make it more difficult to kill these scales with insecticides.

### Life Cycle

Elongate hemlock scale has been found from Virginia to southern New England and as far west as Ohio. In southern and Mid-Atlantic States elongate hemlock scale can complete two generations each year, but usually only one in the Northeast. Crawlers are the only stage capable of dispersing and establishing new infestations. Their dispersal is usually by wind and birds. Elongate hemlock scale usually over-winters either as an egg within the cover of the female or as an inseminated adult female. When crawlers hatch, they exit through a small opening at the posterior end of the cover. Crawlers of both sexes settle beneath the waxy cuticle on the underside of conifer needles and begin feeding. The first-stage nymphs of both sexes secrete a cover around itself as it grows. They molt into a second feeding stage and continue to grow. The second-stage female then molts into the adult feeding stage. The second-stage male molts into a non-feeding pre-pupa, spins a cocoon and pupates, emerging as an adult. They mate with a female soon after emerging and die soon thereafter without feeding. The life stages of the elongate hemlock scale are broadly overlapping everywhere, so crawlers can be found throughout the spring and summer.

### Damage

Foliage will turn a mottled yellow, but premature needle drop has not been documented for Christmas trees. Spruce and fir species tend to be more susceptible than hemlock.

### Control

Removal of declining hemlocks and other susceptible species in areas surrounding the Christmas tree plantation will help to reduce the potential for an outbreak of elongate hemlock scale as infestations tend to intensify following infestations of hemlock woolly adelgid, drought and other stress. Clear-cut blocks of salable size Christmas trees, rather than continually planting young trees next to large, infested trees, so that young trees can grow for a longer time before becoming infested with scales. Rotate scale tolerant species (e.g., Colorado blue spruce) in areas previously troublesome due to scale infestations.

Maintain trees in a healthy condition to discourage buildup of scale populations, but avoid excessive application of nitrogen fertilizers as nitrogen enhances the survival and development rate of the scale.

Thorough drenching applications of dormant oil in early spring when trees are dormant can be effective. Basal pruning of trees can both remove significant portions of the scale populations and provide better access for thoroughly spraying trees. A long extension wand with an upward directed nozzle assists spraying the undersides of lower branches, where the infestations tend to be worse. Additional applications of oil during the growing season (but not while there is tender foliage) may also be necessary. Sprays of systemic or residual insecticides to kill crawlers have not been satisfactory, possibly because of the extended duration of crawler activity. Imidacloprid has no value for controlling armored scales.

### **Pales Weevil** (*Hylobius pales*)

#### Description

The adults are ½-inch long snout beetles, and are black with patches of light-colored scales on their wing covers. Adults over winter in duff under trees, emerging to mate and lay eggs soon after forsythia bloom. Eggs are laid underground on dying pine or spruce stumps from the previous Christmas tree harvest. Eggs hatch into legless grubs, which feed on the cambium and phloem of the stump and roots, completing development and pupating in early-to mid-August. Adults emerge in mid- to late-August. The adults feed extensively on the bark of pencil-diameter side branches and leaders during the fall and spring. Adults can live for more than one year.

#### Damage

Branches partially or totally girdled by adult pales weevils may die outward from where feeding occurred. Partial girdling can cause severe stunting, especially in recent transplants. All species of Christmas trees grown in Connecticut can be damaged by adult pales weevil feeding, however the worst damage has been seen where transplants are placed adjacent to recently cut spruce or pine stumps. Severe injury can occur on trees adjacent to where pine or spruce trees have been dumped.

#### Control

For many years, effective pales weevil control was achieved by spraying stumps with a long residual organochlorine insecticide to kill the adults arriving to lay their eggs. Replacement of this insecticide with organophosphate insecticides has not provided adequate control; use of the longest residual pyrethroids to treat stumps has provided better results. When spraying, be sure to drench the solution around the side of the stump, and spray an area with a radius of 3 feet outwards from the stump. Because even our best treatments are not providing complete control, spraying the leaders of transplants with a long residual pyrethroid is also advisable at the time of planting, especially if these are planted near recently cut stumps. For very severe infestations, a full foliage spray of a pyrethroid may be effective in mid-August to kill newly emerged weevils. Covering stumps with soil or hardwood bark chips does not prevent

reproduction of pales weevils in these stumps. Using kerosene or oil with an insecticide when spraying stumps does not improve control of pales weevil, and is unnecessary.

Thorough drenching applications of dormant oil in early spring when trees are dormant are effective. Additional applications during the growing season may also be necessary.

### **Pine Needle Scale** (*Chionopsis pinifoliae*)

#### Description

Adult females appear as white flecks on conifer needles. The females bear eggs in late summer that over-winter on conifer needles beneath dead, female scales. Tiny, bright red crawlers hatch from the small reddish eggs in mid-May to early June, move to new hosts and begin to feed and grow. They mature in early July and produce a second generation of crawlers by mid-July. The scales secrete and cover themselves with a waxy coating as they grow.

#### Damage

High populations of Pine needle scale can cause death of needles, twigs and whole young trees, particularly Scots, mugo, Austrian and red pines. Spruces and Douglas-firs are also sometimes affected.

#### Control

Monitor insect activity beginning in mid to late April by examining the white shells of the adult females and their feeding sites using a hand lens. The tiny red crawlers should be visible when they become active. Pesticide applications are most effective at this time, before the crawlers settle to feed and begin making their protective cover. Horticultural oil is also useful for controlling this scale.

### **Spruce Spider Mites** (*Oligonychus ununguis*)

#### Description

Spider mites may be distinguished from insects by the absence of discernible body segmentation and the presence of eight (8) rather than six (6) legs through most of their life stages.

They are extremely small, most of them being about 1/50 inch or less in length. They are soft-bodied, oval-shaped reddish colored. Eggs are very tiny and bright red, and can usually be found on the underside of newer shoots in the spring. Often their presence is not detected until they become very numerous and cause obvious plant damage.

## Life Cycle

Spruce spider mites over winter in the egg stage. In the spring and early summer young mites feed on new foliage and when mature they mate and lay eggs for the next generation. There may be at least three generations per year; therefore, eggs may hatch at almost any time, and a new generation can occur every two to three weeks. Spruce spider mite is a cool-temperature adapted species, with populations building up fastest in the spring and the fall. Their numbers often collapse during hot, dry conditions in the summer.

## Damage

Mites have needle-like mouthparts with which they puncture the leaf and suck sap and chlorophyll. Infested foliage becomes mottled or paled and may turn brown and drop prematurely. A fine webbing between the needles and eggs or egg shells on the shoots are also indicative of infestation.

## Control

Spruce spider mites are easiest to monitor by tapping foliage above a sheet of white paper on a clipboard. If more than 50 mites are found in a beating sample, then application of a registered miticide should be considered. Horticultural oil is very useful for spider mite control and is non-toxic to predatory mites. However, oil should only be considered on species in which color change of a waxy bloom (e.g., Colorado blue spruce) or phytotoxicity (e.g., Douglas-fir) is not a problem. Other selective miticides are available that are also compatible with beneficial predators of mites.

Maintaining diverse broadleaved vegetation in row middles may benefit mite management by providing habitat for other mite species and acting as a nursery for predatory mites in the summer when spruce spider mites are at their lowest numbers. The mites on the weeds are not pests because they do not feed on the Christmas trees.

## **Balsam Twig Aphid (*Mindarus abietinus*)**

### Description

Balsam twig aphids occur wherever balsam fir, white fir, and spruce are grown. This aphid feeds on the sap of developing needles on a wide variety of hosts, including balsam, Siberian, alpine, and Fraser firs; white spruce; and juniper. Their feeding causes the needles to twist and distort in shape causing aesthetic injury and stunting of new growth. In Connecticut, injury has only been reported from true firs, and is especially troublesome on balsam fir.

Adult balsam twig aphids are small, (1/16-3/16 inch long) and bluish gray to pale green in color; adults can either have wings or be wingless. The nymphs are small, pale yellowish-green, wingless aphids. Nymphs that develop into egg-laying adults are

slender. Eggs are laid in the crevices of the bark and are brown with small, white rods of wax.

### Life Cycle

Eggs are laid in early summer, and they remain on the tree throughout the fall and winter. In late April to early May, the eggs hatch into the first generation of nymphs that develop into wingless aphids called stem mothers (fundatrices). Stem mothers hatch before bud break, but quickly move onto rapidly expanding growth after bud break where they produce young via live birth. These nymphs may develop into wingless forms called fundagenae or winged forms called sexuparae. The egg-laying adults (sexuales) are winged and are the offspring of either the fundagenae or sexuparae. All of this happens in the spring and early summer. By the end of June, the eggs have been laid on stems and bases of needles of new growth and the adult aphids have disappeared.

### Damage

Balsam twig aphids cause curled needles and roughened bark of infested firs. In extreme cases, defoliation of the tops of Christmas trees has resulted from serious outbreaks. Although trees may tolerate large populations, eventually they will decline in vigor. Christmas tree appearance and market value can be degraded and reduced as a result of balsam twig aphid damage. Virtually all damage to Christmas trees takes place during the period when buds are breaking and during a few weeks while shoots are elongating.

### Control

Balsam twig aphid can be managed by planting species of fir with late bud break, which also avoids problems with frost injury. Balsam twig aphids depend on good synchrony between maturation of the stem mothers and bud break of hosts in order for them to successfully form colonies on developing shoots. This synchrony is common on balsam fir, but there is poor synchrony with the later bud break of Fraser and Canaan firs. Unfortunately, in farms with mixed plantings of fir species, winged sexuparae disperse from balsam firs just in time for bud break on Fraser and Canaan firs, allowing these species to be injured, too.

Chemical control of balsam twig aphids on balsam fir can be difficult because the damage occurs in early spring when weather is unpredictable. During the unusually cold and wet springs, two insecticide applications may be necessary to achieve control.

Damaging infestation levels can be estimated by two methods. (1) Between first bud break and 50% bud break on balsam firs, use a beating sample with a sheet of paper on a clipboard. If any aphids are found, then a spray is warranted. (2) During shoot elongation, count the number of infested shoots and un-infested shoots per 10-inch branch of out mid-crown foliage from 15 or more trees per area. If the average number



of infested shoots is greater than 30 percent, infested trees may need to be sprayed. With early spray timing, a long-residual, non-systemic insecticide can be effective (e.g., bifenthrin). With slightly later spray timing, nearly all of the stem mother aphids would have hatched and short-residual, selective aphicides can be very effective (such as imidacloprid or thiamethoxam in combination with an organosilicone surfactant). Numerous aphid-eating predators such as ladybird beetles, syrphid fly larvae, and lacewing larvae feed on the aphids and can be extremely helpful in suppressing balsam twig aphid populations. Avoid spraying broad-spectrum insecticides when these predators are active. Applying nitrogen fertilizer tends to increase aphid numbers.

### **Conifer Root Aphid (*Prociphilus americanus*) (True firs only)**

#### Description

Conifer root aphids have a complex life cycle which they alternate hosts and habitats between generations and seasons. During the fall, winter and spring, this species feeds on the roots of true firs. They are nearly spherical in shape, are a pale green, and have tufts of waxy wool projecting from their sides. In late May, winged adults emerge from the soil and fly to ash trees. During the summer, most of the aphids develop in colonies within rolled ash leaves, where the aphids are known as the woolly ash aphid. In August, aphids abandon the ash trees and fly back to fir trees. Populations of root aphids in the spring are always associated with one of two sorts of ants, a common field ant (*Lasius* spp.), or more commonly the larger yellow ant (*Acanthomyops interjectus*). Infested trees can be identified by the presence of a ring of ant mounds around the tree. The ants farm the aphids for their honeydew, and will carry aphids to uninfested trees to start new colonies.

#### Damage

Feeding by conifer root aphids causes root injury to roots that show up above ground as nutrient deficiencies and plant yellowing, stunting, and plant death in young trees. Poor color in current season's growth often appears in mid-October at the same time that peak fall foliage color is showing in hardwoods.

#### Control

An application to the soil in the spring or early summer of imidacloprid, just before a rain event will control conifer root aphids on trees that have extensive root systems (trees older than 4 years post-transplanting). For bare-root seedlings or transplants, the roots can be dipped in bifenthrin suspension to protect just those roots from feeding damage. Foliar applications of minor elements during the time of active shoot elongation in June can help mitigate but does not completely prevent late season color problems.

### **Cooley Spruce Gall Adelgid (*Adelges cooleyi*)**

#### Description

Cooley spruce gall adelgids are small, sucking insects, which have distinctive forms that feed on two different types of host. Their feeding causes the formation of elongate, often curved galls about one (1) to three (3) inches long on the end of new growth twigs of Colorado blue, Norway, Englemann, Sitka and oriental spruces. Needle twisting and discoloration damage occurs but galls do not form on their other host, Douglas-fir.

### Life Cycle

Nymphs of one form over winter at the base of the buds of spruce. The form over wintering on Douglas-fir remains on needles. Both forms mature in early spring and deposit their eggs in easily observed masses of white, cottony wax. The eggs hatch after new growth is produced and nymphs migrate to the growing shoots. They pierce the tissues at the base of the needles and suck the plant juices. On spruces, this feeding stimulates formation of cone-like galls at the tip of twigs, enveloping the young aphids. Each gall contains many chambers in which there are several adelgids in each. During the summer the adelgids mature, the galls open, and winged adelgids emerge. These winged females may fly to Douglas-fir or spruce and lay eggs on the needles of the tree. On Douglas-fir, eggs hatching in the spring generate crawlers that move onto newly developing needles.

### Damage

Damage on spruces will appear as elongated green pineapple-like galls at the end of new growth twigs. The galls will turn brown and open in late June or July. Douglas-fir needles become twisted and develop yellow blotches.

### Monitoring

In late winter, look at the needle base below buds for wax covered nymphs. In spring, look on spruce for green galls. On Douglas-fir, look for over wintering adelgids (early black in color, with a fringe of white wax) on needles. Adults and white egg sacs can be found on Douglas fir in spring and summer.

### Control

On spruce, prune out and destroy galls prior to mid summer. Horticultural oil application can be made to control over wintering nymphs in early spring prior to gall formation or in the fall for control of adults and nymphs. However, horticultural oil will discolor blue spruce. Several insecticides are registered for control of Cooley spruce gall adelgid on Douglas-fir with foliar sprays, and a spring application of imidacloprid to the soil immediately prior to or during a rain event also is effective. Horticultural oil is a poor choice for Douglas-fir because it turns foliage yellow.

## **Eastern spruce gall adelgid (*Adelges abietis*)**

### Description

Eastern spruce gall adelgids are very small and not readily seen without magnification. Their feeding causes the formation of pineapple shaped galls which may vary in length from 1/2 to 1 inch at the base of the twigs on Norway, white, red and blue spruces.

### Life Cycle

The adelgids over winter as tiny nymphs at the base of spruce buds. In early spring, the nymphs develop into wingless females that lay their eggs under a fluffy, waxy covering. After the eggs hatch the nymphs insert their mouthparts into the twigs and begin to feed. This feeding causes the plant to form a gall that envelops the young adelgids. In August, the galls crack open and release the mature winged adelgids. These adelgids fly to nearby spruce and lay eggs for the next generation. There is only one generation each year.

### Damage

This insect rarely causes the death of a tree, however, the brown pineapple shaped galls can make the tree unmarketable.

### Monitoring

In late winter, look at the base of needles below buds for white, wax-covered nymphs. Green galls begin to form in spring, especially on Norway spruce. Sticky traps can be used for monitoring to detect flying adults in late summer/early fall.

### Control

Prune out green galls by mid-summer, as they may disfigure the tree because the galls are at the base of the terminal. Pesticide applications are most effective in the fall, but can also be performed in the spring, before migration to new growth occurs.

## **Rust Mites**

Hemlock rust mites and other species of mites in the Family Eriophyiidae are unlike spider mites. Rust mites are triangular, wormlike, translucent white with four legs at the anterior end, and are only about 1/100 of an inch long. Growers often only detect problems with rust mites due to the evidence of the damage they cause—the foliage turns a nearly uniform grayish or rust color. These mites are so small that a 10x hand lens may not be sufficient to see the adults or eggs, so samples should be brought to an expert with a microscope for positive identification. Colorado blue spruce is the species of Christmas tree most commonly affected by rust mites, however, different species of mites can cause damage on white pines and true firs. Rust mites are often our most

cold-hardy pest species, with mites hatching from over wintering eggs in March. Recent data on control of rust mites are not available, however, horticultural oil and certain insecticides and miticides are known to control them.

### **Sawflies (Pine Trees only)**

#### Description

Adults resemble bees or small wasps. Larvae resemble caterpillars that have dark heads with whitish bodies that may be striped or spotted and can be up to 1 1/4 inches long. They are frequently found in clusters near areas where damage symptoms occur. Larvae will respond as a group to disturbances by raising their heads in unison and waving their bodies in an agitated manner.

#### Life Cycle

Eggs that appear as rows of spots are often deposited on the foliage of coniferous and deciduous trees and shrubs. Larvae will often feed in groups on terminal twigs and branches. Most species have one to two generations per year and pre-pupae will over winter in cocoons in duff or in the soil.

#### Damage

Light infestation may appear as skeletonization or defoliation of leaves or needles of branches or shoots. Heavy infestations may cause complete defoliation of trees or shrubs.

#### Monitoring

Look for rows of yellow spots in needles which mark where eggs have been laid. Watch for larvae in May.

#### Control

Application of horticultural oil can be effective for control of small larvae. Otherwise, there are other pesticides that are registered for control of sawflies, however, the potential for negative environmental impact should be considered.

### **White Pine Weevil (*Pissodes strobi*)**

#### Description

The adult white pine weevil is a reddish brown snout beetle about 1/4 inch long, marked irregularly with white scales. Larvae are about 3/8 inches long, curved, legless and white with brown heads.

## Life Cycle

The adults over winter in litter on the ground and resume activity in April. In the spring, the adults go to the terminal shoots and feed on the bark tissue, causing pitch to flow. Tiny glistening drops of resin on the bark or leader indicate adult feeding or egg laying. Eggs are deposited in small punctures in the bark of the leader. The eggs hatch and the legless grubs feed on the inner bark and tissues that produce tree growth. When several larvae are feeding, the shoot is soon girdled and dies. The grubs mature and pupate inside the leaders. Adult beetles emerge from late June to early September. There is one generation per year.

## Damage

Grubs girdle the leader. On pine, the leader may curl into a shepherd's crook shape, turn brown and die. On spruce, the leaders die without curling. Crooked trunks and trees with two leaders develop, making the trees unsaleable. If larvae are allowed to continue feeding, they can travel downwards through multiple years of leader growth, thereby killing several whorls of branches.

## Control

To avoid excessive damage, infested leaders should be cut out and destroyed. Infested leaders must not be left in the field, or some larvae will complete development and emerge as adults. To mitigate the damage, a lateral branch can be taped into an upright position with a bamboo stake support so that it can function as a new leader. Spray leaders, especially of pine and spruce, with a long residual pyrethroid insecticide (e.g., bifenthrin) at the time of forsythia bloom.

## **White grubs**

### Description

C-shaped white grubs with six legs and a brown head capsule are often found in the soil feeding on the roots of Christmas trees and other vegetation. They are the larvae of several scarab beetle species. In Connecticut the most important species are oriental beetle, European chafer, Asiatic garden beetle, and Japanese beetle. The life cycle of these species is very similar. Adults emerge in May – June, mate, and lay eggs in the soil. There are three larval stages that usually develop from the end of July through early October. When cold weather arrives, the larvae dig deeply into the soil—returning to feed closer to the surface again in the spring. Pupae can be found in May and June.

### Damage

White grubs do two types of damage. Grazing of fine roots can cause slight stunting of trees and poorer ability to obtain water and nutrients, resulting in nutrient deficiency symptoms. Feeding and girdling of the main roots can cause more severe damage and

plant death. Girdling injury is most commonly found in seedling beds, liner beds, and among recent transplants to the field.

## Control

An application to the soil in the spring or early summer of imidacloprid, just before a rain event, will control white grubs. For bare-root seedlings or transplants, the roots can be dipped in a bifenthrin suspension to protect just those roots from feeding damage.

## General Diseases

### COMMON DISEASE PROBLEMS:

Botrytis Blight

Sirococcus Blight

Rhabdocline Needlecast

Rhizosphaera Needlecast

Autoecious (Repeating) Spruce Needle Rust

Armillaria Root Rot

Phytophthora Root Rot

Uredinopsis Needle Rust (Fir-Fern Rust)

Swiss Needlecast

Canavigella Needlecast of Pine

Sphaeropsis Tip Blight (formerly called Diplodia Tip Blight)

### I. BOTRYTIS BLIGHT

**1. Causal Agent: *Botrytis cinerea***

**2. Key Hosts: all conifers, especially spruce and fir**

**3. Symptoms and Spread:**

Botrytis blight appeared on a number of conifers in both plantations and landscapes, but white and blue spruce and Douglas fir were particularly affected. *Botrytis* was observed on tender, succulent tips that had emerged during the extended cool, wet, cloudy spring conditions.

Botrytis blight can infect most conifers but is particularly problematic on seedlings, young trees, and trees that have been weakened but not necessarily killed by frost or freeze injury. It is also prevalent during periods of extended cool weather when shoots are elongating and immature tissues are present for longer periods than usual. This spring, many conifers exhibited symptoms of Botrytis infection. Affected tissues initially appear water-soaked and then turn brown. Brown lesions girdle the shoots and cause them to wither and die. As the disease progresses, infections are identified by the gray, fuzzy, cottony growth of the fungus on the surface of needles and shoots. The fungus usually moves from the needles to the shoots and into the stems. With the exception of weak trees, infections usually do not extend beyond the current season's growth and

are often confined to tissues that have been damaged by frost. Botrytis blight is a more serious problem on seedlings or young trees than on established trees. On established trees, infected shoots are walled-off and usually drop. On seedlings, young or weak trees, the fungus can spread into shoots or the main stem where it causes cankers that eventually girdle and kill the shoot or tree. Refer to the fact sheet *Diseases of Christmas Tree Seedling and Transplant Beds* for more details. The fungus is an aggressive saprophyte, so infections often begin on shaded, senescent needles and in other plant debris at the base of a tree.

#### **4. Management:**

- a. Follow sound cultural practices to keep trees as healthy as possible. Weak and frost-damaged tissues are particularly susceptible to infection, so it is important to select appropriate planting sites.
- b. Avoid overcrowding to allow for good air circulation.
- c. Avoid overhead irrigation or water early in the day so the foliage has a chance to dry.
- d. Practice good sanitation.

- spores can be spread from tree to tree by tools, so shear healthy trees first or disinfect tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
- avoid shearing when the foliage is wet to reduce spread of disease;
- diseased tissues should be removed as soon as they are evident in seedling beds;

e. Fungicide sprays are usually not necessary for established trees. However, they can help to minimize damage to seedlings and new transplants.

- among the compounds registered for use in Connecticut are: ferbam, mancozeb chlorothalonil, chlorothalonil + fenarimol, thiophanate methyl and copper sulfate pentahydrate;
- the labels contain information on dosage rates and safety precautions;
- applications can be made when new shoots emerge and are continued as necessary since additional applications may be necessary in years with excessive rainfall.

## **II. SIROCOCCUS BLIGHT**

**1. Causal Agent: *Sirococcus conigenus***

**2. Key Host: many conifers including Douglas fir and blue and white spruce**

### 3. Symptoms and Spread:

Symptoms first appear on succulent shoots and occasionally on 1-year-old twigs in midsummer. Affected shoots often appear at random within the canopy of a tree. However, symptoms are sometimes more pronounced in the lower portions of older trees. This is because low light levels increase the susceptibility of tissues to infection. Blue spruce is highly susceptible and 01-year-old shoots are commonly killed. The fungus attacks at needle bases, girdles the shoot, and results in tip dieback. Infected shoots turn brown and often develop a diagnostic shepherd's crook appearance. Pinpoint, brown fruiting structures of the fungus called pycnidia develop at the bases of infected needles or on infected shoots in mid to late summer or early fall. These are often visible with a hand lens. The fungus overwinters in these killed shoots and in cone scales. Spores of the fungus called conidia are spread by splashing rain or water during spring and into summer. Infections occur when conidia land on succulent tissues of newly emerging shoots during periods of wet weather and when tissues are wet for 24 hours or longer at 10-25°C (50-75°F). The longer the tissues are wet, the more severe the infection.

Infections result in stunting or disfigurement of the growing tips. Young trees are usually more susceptible although trees of any age can be infected. Sirococcus blight rarely kills trees but can disfigure and reduce marketability. However, repeated infections of young trees can result in tree death.

### 4. Management:

- a. Use healthy stock and maintain tree vigor with good weed control, proper fertilization, and attention to planting site.
- b. Rogue severely symptomatic trees.
- c. Prune and remove any dead or dying branches when the bark is dry.
- d. Practice good sanitation.

- spores can be spread from tree to tree by tools, so shear healthy trees first or disinfect tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
- avoid shearing when the foliage is wet to reduce spread of disease;

- e. Use less susceptible varieties, when possible.

- blue spruce is highly susceptible;

- f. Fungicide sprays:

- in *all* cases, coverage is **very** important!
- chlorothalonil, chlorothalonil + fenarimol, thiophanate methyl + chlorothalonil, mancozeb, and azoxystrobin are registered for use;
- the label contains information on dosage rates and safety precautions;



- begin applications before new growth is approximately ½" long and repeat at label intervals depending on rainfall. Sprays should continue until shoots are fully elongated and conditions are no longer favorable for disease.

### III. RHABDOCLINE NEEDLECAST

#### 1. Causal Agent: *Rhabdocline* spp.

#### 2. Key Host: Douglas fir

#### 3. Symptoms and Spread:

Rhabdocline needlecast was first reported in the 1920's and has steadily increased in both incidence and severity for the past eight years. This increase can be attributed to a number of factors including the weather, increased planting of Douglas fir and associated seed sources, and environmental stress. The primary damage associated with this important disease is defoliation, which leads to suppressed growth and to value-loss in Christmas trees.

Symptoms of Rhabdocline first become apparent in late fall or early winter as yellow spots or flecks on one or both surfaces of current season needles. (These symptoms can be confused with feeding damage from the Cooley spruce gall adelgid.) These chlorotic spots gradually turn reddish-brown and can range from 1-2 mm or can encompass the entire needle. A distinctive diagnostic characteristic is the sharp border between the healthy green tissue and the infected brown tissue. Discolored needles are most conspicuous in early spring. Symptoms are often most severe on the lower portion of the tree where air circulation is poor. Although some of the heavily infected needles drop before or during budbreak, most will persist for several months. In late spring, fruiting structures of the fungus develop beneath the epidermis on the lower surface of the needle. The epidermis eventually ruptures and splits open, usually in two longitudinal lines, and exposes the spores of the fungus. These spores are carried by rain and wind to newly expanding needles. When the spores land on immature needles, they germinate, penetrate the cuticle, and begin to grow within the needle. Even though the fungus has infected the needle, no obvious external symptoms are evident until considerably later, by fall or winter. There is only one infection period per year and infection is favored by cool, moist weather and periods of rain. Rhabdocline needlecast is most damaging in plantations where weed growth, close spacing of trees, or dense foliage induced by shearing impede air circulation and prolong wetness on lower branches.

#### 4. Management:

- a. Use healthy stock and maintain tree vigor.
- b. Select the appropriate planting site (slopes with good air drainage) and maintain good weed control to promote good air drainage and dry conditions on lower branches.
- c. Rogue severely symptomatic trees.
- d. Prune and remove any dead or dying branches. There is no need to remove prunings from the plantation floor since the fungus cannot mature on branches once they are cut.
- e. Practice good sanitation.

- spores can be spread from tree to tree by tools, so shear healthy trees first or disinfect tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
- avoid shearing when the foliage is wet to reduce spread of disease;

f. Use resistant varieties when possible.

- seed sources and individual trees **vary greatly** with regard to susceptibility;  
*most resistant*: Shuswap, Pillar Lake;
- *moderately resistant*: Santa Fe, Silver Creek, Coville;  
*most susceptible*: San Isabel, Lincoln, Apache, Cibola, Kaibob, Coconino;

g. Fungicide sprays.

- in *all* cases, coverage is **very** important!
- chlorothalonil, chlorothalonil + fenarimol, and mancozeb are registered for use;
- the label contains information on dosage rates and safety precautions;
- begin applications before new growth is approximately ½" long and repeat for additional sprays at 7- to 14-day intervals depending on rainfall. Sprays should continue until needles are fully elongated and conditions are no longer favorable for disease.

## IV. RHIZOSPHAERA NEEDLECAST

### 1. Causal Agent: *Rhizosphaera kalkhoffii*

### 2. Key Hosts: blue spruce, occasionally white spruce

### 3. Symptoms and Spread:

This needlecast fungus has been causing increasing damage on spruce, especially blue spruce, throughout Connecticut. One reason for this dramatic increase can be explained by the fact that *Rhizosphaera* needlecast is more severe in drought-stressed trees. Although some trees are killed, the primary damage has been premature needlecast. The fungus attacks needles on the lower branches first and gradually progresses up the tree. On severely diseased trees, the infected needles usually fall during their second summer, leaving only the current season's growth on the bottom half. Under epidemic conditions, lower branches may be killed by the fungus.

Current-year needles become infected in May and June, but symptoms do not appear until late fall or the following spring. Diagnostic symptoms may develop in early September but typically occur in spring—infected needles turn a distinctive lavender or purplish brown. At that time, pinpoint black fruiting bodies of the fungus appear in the stomata of the infected needles. These can be seen with a hand lens and appear as

fuzzy, black spots instead of white stomates. During periods of rain and wet weather, spores of the fungus are released and are rain splashed onto newly developing needles where infection occurs. The infection period for this disease can be quite long since infections begin in spring and can continue until autumn.

Rhizosphaera needlecast is often first evident in stands that are naturally moist or that have poor air drainage or in stands adjacent to taller trees that reduce wind-drying of the foliage. *Rhizosphaera* typically infects newly grown needles of the current season but can attack needles of any age that are dying or stressed by other plant pests or environmental factors.

#### **4. Management:**

a. Use healthy stock and maintain tree vigor with good weed control, proper fertilization, and attention to planting site.

b. Prune and remove any dead or dying branches. Remove *all* prunings from the plantation floor since the fungus can mature on branches that are cut.

c. Practice good sanitation.

- spores can be spread from tree to tree by tools, so shear healthy trees first or disinfest tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
- avoid shearing when the foliage is wet to reduce spread of disease.

d. Use resistant varieties, if possible.

- blue spruce is most sensitive, white spruce is intermediate, and Norway spruce is relatively resistant;

e. Fungicide sprays:

- in *all* cases, coverage is **very** important!
- chlorothalonil, chlorothalonil + fenarimol, chlorothalonil + thiophanate methyl, elemental copper, mancozeb, and copper hydroxide are registered for use;
- the label contains information on dosage rates and safety precautions;
- applications can be made when new shoots are approximately 1½" long and again 3 weeks later;
- additional applications may be necessary in years with excessive rainfall.

## **V. AUTOECIOUS (REPEATING) SPRUCE NEEDLE RUST**

**1. Causal Agent: *Chrysomyxa weirii***

**2. Key Hosts: white, black, and blue spruce**

### **3. Symptoms and Spread:**

This needle rust has been present in the state for years but it reappeared in 1996 and its incidence and severity have been on the increase over the past few years. This needle rust is autoecious and does not require any additional hosts in order to complete its life cycle. Infected trees are rarely killed, but the primary damage results in extensive needle discoloration and drop, which reduces the marketability of the infected trees. One of the key features used to distinguish repeating needle rust from other needle rusts is the timing of symptom development. Symptoms appear in early spring, whereas those of the heteroecious rusts appear in mid to late summer.

Symptoms first appear as yellow spots or flecks on needles in late winter and early spring. These spots eventually develop into pustules or blisters (telia) and burst open to reveal masses of yellow-orange spores (teliospores). The teliospores then produce another type of spore (basidiospores) which are readily blown by wind and splashed by rain onto needles of the same tree or onto those of adjacent trees. Infection occurs when needles first emerge and are tender and immature. The following spring, yellow spots and blisters develop on the infected needles and the disease cycle starts again. Blisters of *C. weirii* can appear on both 1<sup>st</sup> and 2<sup>nd</sup>-year needles and heavily infected trees can appear distinctively yellow-orange from a distance. As with most diseases that are not fatal but result in needle drop, repeated defoliation may retard growth and reduce marketability.

### **4. Management:**

- a. Use healthy stock and maintain tree vigor.
- b. Rogue and remove heavily infected trees to reduce inoculum.
- c. Fungicide sprays.
  - in all cases, **coverage and timing** are **very** important;
  - although rust is not specifically listed on the label, chlorothalonil is labeled for spruce and is effective for control;
  - the label contains information on dosage rates and safety precautions;
  - the first application should be made when 10% of the trees have broken some buds; applications should then be made at weekly intervals until needles are mature or until symptomatic needles have dropped to the ground; this is usually 3 sprays, but in years where bud break is slow and the weather is cool and wet (this spring), up to 5 sprays may be necessary.

## **VI. ARMILLARIA ROOT ROT**

### **1. Causal Agent: *Armillaria* spp. (complex)**

### **2. Key Hosts: hundreds of woody plants including most conifers**

### **3. Symptoms and Spread:**

Armillaria root rot, also known as shoestring root rot and honey mushroom root rot, is one of the most common and potentially damaging diseases of forest, plantation, shade, and ornamental trees worldwide. It is now known that this disease is caused by a number of different species of *Armillaria*, and the severity of the disease is partly determined by the particular species that are present. Part of the destructive capability of this disease is the ability of these fungi to live for many years in decaying wood and roots in the soil. In addition, these fungi can take advantage of weakened or stressed trees, particularly trees under drought stress.

Above ground symptoms of this disease are not very distinctive but include suppressed growth, yellowed or undersized needles, premature needle drop, branch dieback, and sudden death of trees in mid-summer. Dying conifers sometimes produce a distress crop of numerous small cones. In resinous conifers, infection often stimulates heavy flow of resin that may saturate the bark and wood or even seep out onto the surface and into the surrounding soil and litter.

*Armillaria* is often recognized by its fruiting structure which is a fleshy, firm, honey-colored mushroom that forms annually in autumn in groups of a few or up to 100 or more in a cluster at the base of an infected tree or stump. A white fan of fungal growth can often be found directly under the bark of a diseased tree. Dark-brown rhizomorphs (very coarse, shoestring-like threads) may be found under the bark or on the surface of the roots or trunks of hardwoods. These structures are rarely found on conifers.

*Armillaria* invades the bark and cambium of the roots and the root collar and kills the roots. The rhizomorphs typically grow out from infected roots through the soil. When they come in direct contact with healthy roots, the fungus penetrates the root and grows along the cambium layer. It then works its way up to the root crown where it girdles the tree.

Root rot can be severe in young Christmas tree plantations that are established on land where broadleaved trees, especially oaks, formerly grew. These trees are at high risk since the stumps and roots of the newly removed trees provide abundant food sources for the fungus. Young, newly planted trees are the most sensitive and trees fortunately become more resistant with age. Patterns of damage within a plantation are often focused around a tree stump. As a result, diseased trees often occur in groups. Two conditions must usually be met before lethal attack occurs: 1) the pathogen must have a large energy source or food base such as a colonized tree stump or root and 2) the threatened trees must be under physiological stress from any number of factors including drought, excess water, or defoliation by insects or needlecasts.

#### **4. Management:**

- a. Use healthy stock and maintain optimum tree vigor by proper fertilization, planting practices, and attention to planting site.
- b. Remove stumps and roots of recently felled hardwoods (especially oaks) adjacent to or in the direct vicinity of new plantations.
- c. If disease is detected on a tree or trees within the plantation, expose the entire root collar area and as much of the butt as possible to the air for several months. This

encourages drying of the wood and creates a condition which is unfavorable for growth of the fungus.

d. No fungicides are effective for control.

## VII. PHYTOPHTHORA ROOT ROT

1. **Causal Agent:** *Phytophthora spp.*

2. **Key Hosts:** Hundreds of woody plants including most conifers

3. **Symptoms and Spread:**

Above ground symptoms of this disease are not very distinctive, a characteristic typical of most root rot diseases. Included among the symptoms of Phytophthora root rot are suppressed growth, poor vigor, yellowed or undersized needles, premature needle drop, branch dieback, wilt, and death of trees at any time during the season. Diagnostic symptoms can usually be seen at the base of the infected tree, either as extensive resin-flow on the outer bark or cracking in the root-crown area. A characteristic and distinctive cinnamon-brown discoloration is usually evident when cuts are made into the wood in this area.

Phytophthora root rot is often associated with drainage problems and wet sites. This soil-borne pathogen (previously called a “water mold”) produces motile spores that readily move in water. As a consequence, declining trees often follow drainage patterns in plantations, especially those sites on hills: an infected tree at the top of the drainage pattern can effectively inoculate the trees below.

Root rot can be severe in young Christmas tree plantations since young, newly planted trees are the most sensitive. Fortunately, trees become more resistant but not immune, with age. Phytophthora root rot can also be a problem in seedling and transplant beds. Roots appeared distinctly cinnamon brown in color. Refer to the fact sheet *Diseases of Christmas Tree Seedling and Transplant Beds* for more details.

4. **Management:**

a. Use healthy stock. Carefully inspect transplants from seedling beds.

b. Avoid planting in poorly drained sites or improve drainage.

c. Maintain vigor by proper fertilization (based on soil tests) and planting practices; avoid excessive irrigation.

d. Rogue and remove symptomatic trees.

e. Fungicides: **NOTE:** fungicides cannot be used in a curative fashion. Infected trees cannot be cured.

- healthy, uninfected plants adjacent to symptomatic plants can be *protected* with fungicides; Fosetyl – A1 and mefenoxam are registered for use.
- the label contains information on dosage rates and safety precautions.

## VIII. UREDINOPSIS NEEDLE RUST (FIR-FERN RUST)

### 1. Causal Agent: *Uredinopsis pteridis*

### 2. Key Hosts: many true firs, particularly grand and white fir

### 3. Alternate Hosts: bracken fern

### 4. Symptoms and Spread:

Although this needle rust is an occasional problem in Connecticut, and occurs when true firs grow in close proximity to ferns, the alternate hosts. Symptoms on firs consist of chlorotic to yellow blotches on the upper surfaces of infected needles. These can appear in spring on 1-month-old to several year-old needles. Diagnostic symptoms develop on the under surface of the infected needles and appear as white, tubular projections through the stomates. White-colored spores are produced in these structures and are dispersed to the alternate fern hosts, particularly bracken ferns. Infected needles dry out and drop prematurely, often in quantities that render the trees unmarketable.

Symptoms on bracken ferns, the alternate hosts, appear as elongated chlorotic spots. These are most apparent on the upper surface of the frond and are often located between the veins. The undersides of the fronds often appear white due to abundant sporulation of the rust fungus. Unlike most rust fungi whose spores are rusty brown, spores of fir-fern are white. The fungus overwinters in dead bracken fern fronds. In spring, spores are produced in the fern debris and are carried by wind and rain to infect newly developing needles of true firs in the vicinity. About one month after infection, inconspicuous fruiting bodies develop on infected needles but symptoms usually don't appear until the following year. During late winter and early spring, white, tubular structures are produced on the undersides of infected needles. White spores are released and carried by the wind and rain to young, unrolling frond of bracken ferns and the cycle begins once again. Although spore production is most prevalent in spring, it can continue into the summer and fall. Infected needles can produce spores for 3-4 years or until they dry up and die.

### 5. Management

- a. Use healthy stock and maintain tree vigor.
- b. Encourage good air circulation by site selection and weed control.
- c. Rogue and remove heavily infected trees to reduce inoculum.

**d. Remove the alternate hosts, bracken ferns, from the periphery and within the plantation. This can be accomplished by mowing or by herbicide sprays.**

e. Fungicide sprays.

- in all cases, coverage and timing are very important;
- triadimefon is labeled for true firs and is effective for control; **do not use triadimefon on Concolor fir**; mancozeb can be used on Concolor fir;
- the label contains information on dosage rates and safety precautions;
- the first application should be made at budbreak and repeated at 10-day intervals for two additional applications;
- if ferns are only located at the edge of the plantation, the only trees that need to be sprayed are in the first five to ten rows adjacent to the border where the ferns are growing.

## **IX. SWISS NEEDLECAST**

**1. Causal Agent: *Phaeocryptopus gaumanni***

**2. Key Hosts: Douglas fir**

**3. Symptoms and Spread:**

This needlecast reappeared recently in both plantation and landscape trees after several years of absence. Symptoms are usually evident in late winter and early spring and appear on previous year's or two year old needles. Affected needles appear yellow or mottled and gradually turn brown, often with a "dirty" appearance. When the undersides of the needles are examined with a hand lens, two bands of round, black fruiting bodies can be seen on either side of the midrib. With the naked eye, these bands look like "dirt". The fruiting bodies are structures of the fungus which grow right out of the stomates. Symptoms typically develop on 1<sup>st</sup> year needles prior to their 2<sup>nd</sup> year or on 2<sup>nd</sup> year needles prior to their 3<sup>rd</sup> year. However, fruiting structures of the fungus can be present on needles that still appear green and "healthy". As a consequence, infected needles can persist on the tree for two or three seasons before they are cast. Because green needles can be infected and serve as a source of inoculum, it is not uncommon for this disease to develop without much notice until a significant number of trees are infected. Repeated infections may weaken trees and severely infected trees usually only maintain current season needles on their lower branches. In extreme circumstances, disease may result in the death of branches up to 3 ft or more above the ground and may kill trees. After harvest, trees with green but infected needles dry out and lose their needles more rapidly than healthy, cut trees.

Infection occurs in spring when spores are released from the fruiting bodies. Diseased needles can produce spores for 1, 2, or 3 seasons. Spores are disseminated by wind or splashing rain and infect newly emerging needles in late spring and early summer



during shoot elongation. Abundant moisture, high humidity, and cool temperatures are favorable for disease development.

Swiss needlecast is often confused with “sooty mold” which is a superficial, unsightly but non-pathogenic fungus that grows upon the honeydew or excrement of insects. Sooty mold can be distinguished from the fruiting structures of the Swiss needlecast fungus by examination with a hand lens. With the latter, individual fruiting structures appear in rows whereas the sooty mold fungus appears as an amorphous mass of hyphae without any structure or definition.

#### **4. Management:**

- a. Use healthy stock and maintain tree vigor with good weed control, proper fertilization, and attention to planting site.
- b. Practice good sanitation.
  - spores can be spread from tree to tree by tools so shear healthy trees first or disinfect tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
  - avoid shearing when the foliage is wet to reduce spread of disease.
- c. Remove and destroy heavily infected or cull trees in and around the plantation to reduce the amount of inoculum.
- d. Fungicide sprays.
  - in *all* cases, coverage is **very** important!
  - Chlorothalonil and chlorothalonil + fenarimol, and mancozeb are registered for use;
  - the label contains information on dosage rates and safety precautions;
  - applications can be made when new shoots are approximately 1-1 ½” long and again 3 weeks later;
  - additional applications may be necessary in years with excessive rainfall.

## **X. CANAVIRGELLA NEEDLECAST OF PINE**

### **1. Causal Agent: *Canavirgella banfieldii***

### **2. Key Hosts: Eastern white pine and Macedonian white pine**

### **3. Symptoms and Spread:**

In August 1998, The Plant Disease Information Office started to receive an unusual number of phone inquiries and samples of ailing white pines from throughout the state. The symptoms on the trees were distinctly different from those associated with diseases

of white pine previously reported in Connecticut. After extensive microscopic examination and search of the literature, the disease was identified as *Canavirgella* Needlecast. This disease has never been reported for Connecticut although it is thought to be present along the eastern seaboard, from North Carolina to Maine. The first report documenting this needlecast disease appeared in 1996.

Infected trees appear distinctly reddish brown from a distance in late July and early August. Upon close inspection, the symptoms are usually confined to current-season needles. Tips of infected needles first appear yellowish tan and develop a distinct reddish brown color by late August. By the following spring, infected needles curl and fade to tan or gray. One of the diagnostic characteristics of the disease is that not all needles within a fascicle are infected. Additionally, individual needles within a fascicle may exhibit differing amounts of symptomatic tissue. When needles are infected with *Canavirgella*, the bases of symptomatic needles usually remain green and the needles and the fascicle often remain attached to the tree. Symptomatic portions of individual needles may break off before the fascicles drop during periods of normal needle shedding. The general symptoms of this needlecast have frequently been confused with those associated with acute ozone injury and other needlecast diseases. However, with ozone, symptoms usually develop on all of the needles within a fascicle and needles exhibit the same extent of injury.

Infection of succulent, elongating current-season needles apparently occurs in late June or early July. The spores (ascospores) of the fungus are thought to be released during early stages of needle elongation and during periods of favorable weather. As with most needlecast pathogens, extended periods with free water on the needles are conducive for infection. The disease does not appear to be site-specific since heavily infected trees have been found on warm, exposed south-facing slopes as well as on cool, moist, north-facing exposures.

#### **4. Management:**

- a. Use healthy stock and maintain tree vigor with good weed control, proper fertilization, and attention to planting site.
- b. Practice good sanitation.
  - spores can be spread from tree to tree by tools, so shear healthy trees first or disinfect tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
  - avoid shearing when the foliage is wet to reduce spread of disease;
- c. Fungicide sprays.
  - because of the newness of this disease to Connecticut, specific fungicides are not labeled for use. Please contact the Experiment Station for the most current information on control.

## **XI. SPHAEROPSIS TIP BLIGHT (formerly called Diplodia Tip Blight)**

### **1. Causal Agent: *Sphaeropsis sapinea***

### **2. Key Hosts: Douglas fir, blue, Norway, and white spruce, Scots pine**

### **3. Symptoms and Spread:**

Sphaeropsis tip blight, formerly called Diplodia tip blight, can be a destructive and devastating disease of conifers, especially when growing under conditions of stress. It has been quite prevalent on 2-3 needled pines in the Connecticut landscape and has recently been diagnosed on several species of Christmas trees. The fungus usually attacks only mature trees although it can be damaging to young trees that have been under stress from drought, excessive soil moisture, root restriction, and other site problems or stresses. Symptoms often first appear on the current season's needles since the fungus rapidly kills infected young, succulent shoots before the needles are fully elongated. As a consequence, needles on such shoots are often stunted. Infected shoots turn yellow, gradually brown, and fruiting structures of the fungus are visible as small black structures with conical breaks at the base of the infected needles. A diagnostic feature of Sphaeropsis tip blight is the presence of stunted, straw-colored shoots with short needles and resin flow. In trees that are relatively free from stress, tip blight only kills the current-season buds and shoots. Older twigs and branches are damaged only if trees are predisposed by stress. In cases where disease is severe, shoots are blighted and branches are deformed.

Sphaeropsis tip blight also attacks older shoots through wounds, including those caused by insect injury. These infections often result in perennial, bleeding twig and stem cankers but in severe cases can lead to girdling, branch death, and significant disfigurement of the tree.

Disease is favored by wet spring weather which promotes fungal growth and infection. Spores of the fungus are only spread during periods of rainfall and trees are particularly susceptible to infection in the early spring. Once again, trees which are predisposed by stress are much more susceptible than their stress-free counterparts.

### **4. Management:**

- a. Prune and remove blighted twigs and branches during dry weather in autumn.
- b. Maintain optimum tree vigor by following sound cultural practices.
- c. Water during periods of drought.
- d. Practice good sanitation.
  - spores can be spread from tree to tree by tools, so shear healthy trees first or disinfect tools between cuts with household bleach (1 part bleach: 9 parts water) or 70% alcohol;
  - avoid shearing when the foliage is wet to reduce spread of disease.

e. Fungicide sprays.

- In all cases, coverage is **very** important!
- Thiophanate-methyl and mancozeb are registered for use;
- The label contains information on dosage rates and safety precautions;
- The first application should be made **before** any bud sheaths have broken and can be repeated two or three times at 10 – 14 day intervals as necessary.

#### **OTHER DISEASES:**

Numerous other diseases that can occur in Connecticut Christmas tree plantations are not covered in this handout. Please refer to previous editions of *Disease Problems in Connecticut Christmas Tree Plantations* for more detailed information about many of these diseases. This handout is updated on a yearly basis. Copies are available upon request or at the Connecticut Agricultural Experiment Station website:

[www.cases.state.ct.us](http://www.cases.state.ct.us).

#### **SELECTED REFERENCES:**

There are a number of good websites and reference books on diseases and insect pests of Christmas trees and conifers.

##### ***USDA Christmas Tree Pest Manual***

<http://www.na.fs.fed.us/spfo/pubs/misc/xmastree/>

##### ***Cornell University Christmas Tree Pests***

<http://ppathw3.cals.cornell.edu/Trees/Treepests.html>

##### ***Penn State-Pennsylvania Christmas Trees***

<http://ctrees.cas.psu.edu/default.html>

***Christmas Tree Pest Manual, 2<sup>nd</sup> Edition***, 1998, D. G. McCullough, S. A. Katovich, M. E. Ostry, and J. Cummings-Carlson, Michigan State University, 143 pp., \$20.00. Extension Bulletin E-2676. Order from MSU Bulletin Office, 10-B Agricultural Hall, Michigan State University, East Lansing, MI 49924-1039, (517) 355-0240.

***Christmas Tree Diseases, Insects, & Disorders in the Pacific Northwest: Identification and Management***, 1997, G. A. Chastagner, Washington State University, 154 pp., \$25.00 + \$4.00 shipping. Bulletin MISC0186. Order from Washington State University Cooperative Extension, Bulletin Office, P. O. Box 645912, Pullman, WA 99164-5912.

***Compendium of Conifer Diseases***, 1997, E. M. Hansen and K. J. Lewis, APS Press, St. Paul, MN, 124 pp., \$49.00. ISBN 0-89054-183-3. Order from APS Press, The American Phytopathological Society, 3340 Pilot Knob Road, St. Paul, MN 55121-2097, (800) 328-7560. Website: <http://www.shopapspress.org>.

## Worker Protection Standard

Below is a *brief summary* of the Worker Protection Standard (WPS). The WPS is a federal regulation that is aimed at reducing the risk of pesticide exposures for employees of agricultural operations. Pesticide labels for all products that are used in agricultural production now refer to the WPS and, therefore, compliance with the entire regulation is required. Agricultural business owners and managers should familiarize themselves with these requirements by reading the "How To Comply Manual" or by going to EPA's website <http://www.epa.gov/oppfead1/safety>. You may also direct any questions that you may have to the State of Connecticut, DEP, Pesticide Management Program by calling 860/424-3369.

Under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA) it is unlawful for any person to use a pesticide in a manner inconsistent with its labeling. When the WPS is referenced on a pesticide label, users must comply with all of its requirements or be subject to enforcement action, which may include monetary penalties.

### Basic Principles of the Worker Protection Standard

EPA's Worker Protection Standard (WPS) is intended to reduce the risk of pesticide poisonings and injuries among persons who are employed at farms, forests, nurseries or greenhouses. The WPS contains requirements for pesticide safety training, notification of pesticide applications, use of personal protective equipment, restricted entry intervals following pesticide application, decontamination supplies, and emergency medical assistance.

The WPS identifies almost all agricultural employees as agricultural workers, early-entry workers or pesticide handlers depending upon the duties they perform. They are distinguished as follows;

**Agricultural Workers** are those who perform hand labor tasks related to the planting, cultivation and harvesting of plants on farms or in greenhouses, nurseries, or forests. Workers include anyone employed for any type of compensation (including self-employed) doing tasks, such as carrying nursery stock, repotting plants, or planting, weeding, hoeing or watering, related to the production of agricultural plants on an agricultural establishment.

Workers do NOT include employees such as office employees, truck drivers, mechanics, and any other workers not engaged in worker/handler activities.

**Early-Entry Workers** are workers that, under limited circumstances, may be asked to enter a pesticide treated area before the expiration of the restricted entry interval to perform limited tasks. Employers must provide special protections to early entry workers such as additional training and instructions, decontamination sites and label specific personal protective equipment.

**Pesticide Handlers** are those who mix, load, assist with or apply agricultural pesticides; clean, maintain or repair equipment that is used pesticide applications; or perform other tasks that may bring them into direct contact with pesticides.

The WPS does not apply when pesticides are applied on an agricultural establishment in the following circumstances:

- For mosquito abatement, Mediterranean fruit fly eradication, or similar wide-area public pest control programs sponsored by governmental entities. The WPS does apply to cooperative programs in which the growers themselves make or arrange for pesticide applications.
- On livestock or other animals, or in or about animal premises.
- On plants grown for other than commercial or research purposes, such as home fruit and vegetable gardens, and home greenhouses.
- On plants that are in ornamental gardens, parks, and public or private lawns and grounds that are intended only for aesthetic purposes or climatic modification.
- By injection directly into agricultural plants. Direct injection does not include "hack and squirt," "frill and spray," chemigation, soil-incorporation, or soil-injection.
- In a manner not directly related to the production of agricultural plants, such as structural pest control, control of vegetation along rights-of-way and in other noncrop areas, and pasture and rangeland use.
- For control of vertebrate pests.
- As attractants or repellents in traps.
- On the harvested portions of agricultural plants or on harvested timber.
- For research uses of unregistered pesticides.

## **Summary of WPS Requirements**

### **Protection During Applications**

Pesticide handlers (applicators) are prohibited from applying a pesticide in a way that will expose workers or other persons. Workers are not allowed to enter areas where pesticides are being applied. In some circumstances, workers must remain outside of prescribed buffer zones that may be from 25 to 100 feet, depending upon where a pesticide is applied and the method of application, until the application has been completed.

### **Restricted-entry Intervals (REI)**

Restricted-entry intervals are specified on all agricultural plant pesticide product labels. Usually REI's are 12, 24 or 72 hours, although some low toxicity products may have a zero hour REI. Workers are excluded from entering a pesticide treated area during the restricted entry interval.

## **Personal Protective Equipment**

Personal protective equipment (PPE) that is specified on the pesticide label must be provided and maintained for handlers and early-entry workers. PPE must be inspected and cleaned prior to each use.

## **Notification of Workers**

Workers must be notified about treated areas either orally, by posting of signs or both, as indicated on the pesticide label, in order to avoid inadvertent exposures. Workers that are on the premises at the start of the applications must be orally warned before the application takes place. Workers that are not on the premises at the start of the application must be orally warned at the beginning of their first work period if (1) the application is still taking place or (2) if the REI for the pesticide is still in effect.

## **Pesticide Safety Training**

Specific training is required for all workers, early-entry workers and handlers and must be conducted in a language that they understand. Generally, certified private applicators, commercial supervisors or persons that have attended a state approved train the trainer session can train workers and handlers. Those that have been trained as "handlers" can also train workers. EPA has developed WPS training materials for workers and handlers that are available as booklets, flip charts and videotapes, some of which is available in languages other than English. The training must contain at least the concepts as described in the "How To Comply Manual - Criteria for Worker and Handler Training".

## **Central Posting**

Agricultural employers must post specific information at a central location that is accessible to their employees. The information that is required to be posted is as follows:

- **Application list**, which must include the location and description of the area to be treated, the product name, EPA registration number, and active ingredients of the pesticide, the time and date the pesticide is scheduled to be applied and the REI.
- **Emergency information**, which must include the name, telephone number and address of the nearest emergency medical facility.
- A **pesticide safety poster**, which must be either the WPS safety poster developed by EPA or an equivalent poster as described in the "How To Comply Manual - Criteria for Pesticide Safety Poster"

## **Access to Labeling and Site-Specific Information**

Handlers and workers must be informed of required pesticide label information. Central posting of recent pesticide applications is required.

## **Decontamination Supplies**

Handlers and workers must have an ample supply of water, soap and towels for routine

washing and emergency decontamination, and a change of clothes as specified in the regulation and the How to Comply Manual.

### **Emergency Assistance**

Transportation must be made available to a medical care facility if there is a reason to believe that a worker or handler may have been poisoned or injured by a pesticide used on the agricultural establishment. Information must be provided to medical personnel about the pesticide to which the person may have been exposed.

### **Revisions of the Worker Protection Standard**

The Environmental Protection Agency made several revisions to the WPS in April 1995. The revisions that are pertinent to Connecticut applicators are summarized below.

#### **I. Training Requirements**

As of January 1, 1996, employers must provide brief pesticide safety training to untrained agricultural workers before they enter pesticide treated areas. Employers must be able to verify compliance with this requirement. The brief pesticide safety training must consist of those components highlighted on the WPS safety poster and a statement to workers that complete Pesticide Safety Training will be provided before the end of the 6th day of entering a treated area. This differs from the original 1992 WPS, which allowed a 15-day grace period for complete WPS worker training until October 1997.

The basic pesticide safety information must include the following concepts:

- Pesticide may be on or in plants, soil, irrigation water, or drifting from nearby applications.
- Prevent pesticides from entering your body by:
  - \*Following directions and/or signs about keeping out of treated or restricted areas
  - \*Washing before eating, drinking, using chewing gum or tobacco, or using the toilet
  - \*Wearing work clothing that protects the body from pesticide residues
  - \*Washing/showering with soap and water, shampoo hair and put on clean clothes after work
  - \*Washing work clothes separately from other clothes before wearing them again
  - \*Washing immediately in the nearest clean water if pesticides are spilled or sprayed on the body and, as soon as possible, showering, shampooing, and changing into clean clothes.
- Further training will be provided before the 6<sup>th</sup> day that a worker enters any area on the agricultural establishment where within the last 30 days, a pesticide has been applied or a REI has been in effect.

To clarify: before working in an area treated with pesticides, an agricultural worker must receive basic pesticide training. Prior to day 6, he must receive complete worker training as described in the "How To Comply Manual." The complete training



information is included in EPA's manual entitled, "Protect Yourself from Pesticides-A Guide for Agricultural Workers", or various EPA approved videotapes. Once a worker receives complete WPS training, he will not be required to be retrained for a period of 5 years.

Nothing in this exception changes the WPS training requirements for agricultural pesticide handlers.

## **II. Exception for Limited Contact Tasks/Early Entry Workers**

Agricultural pesticide labels specify a restricted entry level (REI), usually ranging from 12 to 72 hours. The WPS had limited early entry worker activity in treated areas under an REI to 1 hour in a 24-hour period. EPA granted an exception to the WPS that would allow, under specified conditions, workers to enter pesticide treated areas during an REI to perform limited contact tasks that could not be foreseen and which, if delayed until the expiration of the REI, would cause significant economic loss. Some examples of limited contact tasks that qualify for the exception include: the operation and repair of weather monitoring and frost protection equipment; the repair of greenhouse heating, air conditioning and ventilation equipment; the repair of non-application field equipment; the maintenance and moving of beehives. Some examples of hand labor activities and other tasks which would not qualify for this exception include: harvesting; thinning; weeding; topping; planting; sucker removal; packing produce into containers in the field; operating, moving or repairing irrigation equipment; and performing the task of a crop advisor.

This exception increases the time workers will be able to remain in treated areas under an REI for early entry activities from 1 hour to 8 hours within a 24-hour period **providing the following conditions are met:**

- 1) The worker's contact with treated surfaces is minimal and is limited to the feet, lower legs, hands and forearms.
- 2) The pesticide product does not have a statement in the labeling requiring workers to be notified both orally and by posting;
- 3) Personal protective equipment for early entry is provided to the worker and must either conform with the label requirements or include at least coveralls, chemical resistant gloves, shoes plus socks, chemical resistant footwear, and protective eyewear (if protective eyewear is required for handlers by the product labeling);
- 4) No hand labor such as hoeing, picking, pruning, etc. is performed;
- 5) The workers do not enter the treated area during the first 4 hours, and until applicable ventilation criteria have been met, and until any label specific inhalation exposure level has been reached;

6) Before early entry workers enter a treated area under an REI, the agricultural employer shall give them oral or written notification of the specifics of the exception to early entry as indicated on the pesticide label in a language the workers understand.

NOTE: Since this exception allows tasks to be performed during the REI, all persons engaged in the tasks under this exception must be trained as early entry workers as described in the How To Comply Manual or as a Handler prior to performing the tasks, in accordance with WPS.

### III. Exception for Irrigation Tasks

EPA completed an exception to the WPS that allows early entry workers under specified conditions, to enter pesticide treated areas during a REI to perform irrigation tasks related to operating, moving or repairing irrigation or watering equipment. This exception extends the time that a trained early entry worker may remain in a pesticide treated area to perform irrigation tasks from one hour to 8 hours within a 24 hour period.

The terms of this exception further require that the need for the task could not have been foreseen and cannot be delayed until after the expiration of the REI. A task that cannot be delayed is one that, if not performed before the REI expires, would cause significant economic loss, and there are no alternative practices, which would prevent significant loss. (Discussions are currently underway with EPA to address watering needs in the greenhouse setting. At present, **this exception does not apply to routine watering needs in a greenhouse** since the need is not viewed as one that could not have been foreseen)

In addition to the above criteria, the terms of the exception for irrigation activities requires compliance with items 1 through 6 listed above for the limited contact exception.

### IV. Reduced Restricted Entry Intervals for Low Risk Pesticides

The WPS established an interim minimum REI of 12 hours for all end use pesticide products for agricultural uses. However, EPA had been asked to consider reducing the minimum 12-hour REI for certain lower toxicity products. EPA determined that the reduction of the REI for specific low risk pesticides can be accomplished without jeopardizing worker safety and would also promote the use of less toxic products over those with greater risks and longer REI's. Therefore, EPA established a regulation to reduce the REI on 114 lower toxicity products to 4 hours or, in some cases, zero hours. EPA has instructed registrants to revise the labels of affected products to meet certain criteria. Pesticide users should examine labels closely for stickers or other indications of a reduced REI in accordance with this regulation.

The affected lower risk pesticides generally consist of microbial pesticides, biochemical pesticides and certain conventional agricultural pesticides.

## V. Warning Signs

EPA amended the WPS to modify the warning sign size and language requirement. The amendment allows the substitution of the language commonly spoken and read by workers for the Spanish portion of the warning sign. The sign must be in the same format required by WPS and it must be visible and legible. Use of alternative languages is optional and the use of Spanish/English is always acceptable.

The amendment also allows the use of smaller signs provided that the minimum letter size and posting distance requirements are observed. In nurseries and greenhouses, smaller signs may be used at any time. A small sign may be used on a forest or farm if the treated area is too small to accommodate the standard sign.



SPANISH

For more information on the scope of the WPS, consult the How to Comply Manual or on the Internet at [www.epa.gov/pesticides/safety](http://www.epa.gov/pesticides/safety).

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