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NEEDLECASTS OF DOUGLAS-FIR

Two of the most common diseases of Douglas-fir (*Pseudotsuga menziesii*) growing in Connecticut are Rhabdocline needlecast and Swiss needlecast. Although both diseases are generally considered more aesthetic or cosmetic than life-threatening, they can result in premature defoliation and deformity of heavily infected trees.

RHABDOCLINE NEEDLECAST

Rhabdocline needlecast is the most common disease of Douglas-fir. Outbreaks continue to plague many landscape trees as well as trees in Christmas tree plantations throughout Connecticut. This disease was first reported in the 1920's and has steadily increased in both incidence and severity for the past few years. This increase can be attributed to a number of factors including the weather, increased popularity of planting Douglas-firs as landscape trees, and environmental stress. The primary damage associated with this important disease is defoliation, which leads to suppressed growth, occasional deformity, and value loss in Christmas trees.

SYMPTOMS AND DISEASE DEVELOPMENT:

Rhabdocline needlecast is caused by the fungus *Rhabdocline* spp. Symptoms 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 often be confused with feeding damage from the Cooley spruce gall adelgid. The chlorotic spots gradually turn reddish-brown and enlarge. Depending upon the extent of the infection, they can range in size from small, 1- to 2 mm areas, to large brown areas that encompass an entire needle.

A distinctive diagnostic symptom is the sharp border between the healthy green tissue and the infected brown tissue (Figure 1). Discolored needles are most conspicuous in early spring.

Figure 1. Diagnostic brown banding pattern of infected needles. Symptoms become visible in late winter and early spring.

Symptoms are often most severe in 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.

Figure 2. One-year-old needles infected with *Rhabdocline* spp. provide the inoculum to infect the flush of new, susceptible needles (light green).

In late spring, fruiting structures of the fungus develop beneath the epidermis on the lower surface of the needle. The epidermis eventually splits open, usually in two longitudinal lines, and exposes the spores of the fungus (Figures 3 and 4). These spores are carried by rain and wind to newly expanding needles.

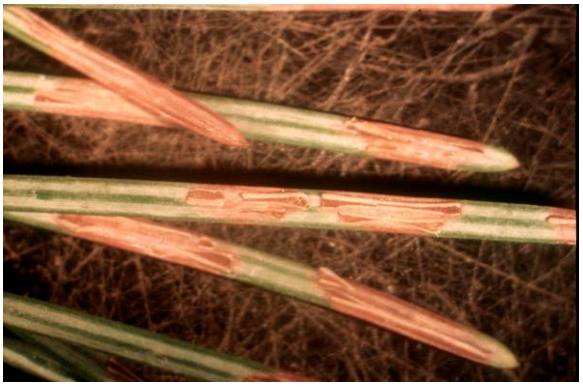

Figure 3. In spring, the epidermis on the lower surfaces of infected needles ruptures in two longitudinal lines.

When the spores land on immature needles they germinate, penetrate the cuticle, and begin to grow within the needle. Although the fungus has already infected the needle, no obvious external symptoms are evident until considerably later, usually by fall or winter.

Figure 4. Close-up of longitudinal splits on the underside of a symptomatic needle. The orange fungal mass will develop into spores that incite new infections.

There is only one infection period per year; infection is favored by cool, moist weather and periods of rain. Rhabdocline needlecast is most damaging in sites where weed growth, close spacing of trees, or dense foliage impede air circulation and prolong wetness on lower branches.

MANAGEMENT STRATEGIES:

Rhabdocline needlecast is not considered a life-threatening disease and can be managed through the combined use of culture, sanitation, resistance, and fungicide sprays. Cultural methods include use of healthy stock and maintaining of tree vigor by following sound cultural practices. It is also helpful to select the appropriate planting site (slopes with good air drainage) and maintain good weed control to promote good air drainage and conditions that help to dry the lower branches.

Sanitation includes pruning and removing any dead or dying branches. There is no need to remove prunings from the vicinity of the tree since the fungus cannot mature on branches once they are cut. It is often

necessary to remove severely symptomatic trees to reduce the amount of inoculum. Since spores can be spread from tree to tree by tools, it is helpful to disinfest tools between cuts with household bleach (1 part bleach: 9 parts water), 70% alcohol, or one of the commercially available compounds such as Greenshield®. To reduce spread of disease, pruning should not be done when the foliage is wet.

Resistant seed sources are also available although individual trees *vary greatly* with regard to susceptibility. Among the most resistant are Shuswap and Pillar Lake; Santa Fe, Silver Creek, and Coville are moderately resistant; San Isabel, Lincoln, Apache, Cibola, Kaibob, and Coconino are the most susceptible.

The final strategy for disease management involves the proper selection, timing, and application of fungicide sprays. Thorough coverage of all parts of the tree is necessary. Among the compounds registered for use in Connecticut are chlorothalonil, chlorothalonil + fenarimol, and mancozeb. The labels contain information on dosage rates and safety precautions. Applications are made before or when new growth is approximately ½" long and are repeated for additional sprays at 7- to 14-day intervals depending on rainfall. Sprays should continue until needles are fully elongated and mature, or when conditions are no longer favorable for disease.

SWISS NEEDLECAST

After a number of years of absence, this needlecast has reappeared in both landscape and plantation trees in Connecticut.

SYMPTOMS AND DISEASE DEVELOPMENT:

Swiss needlecast is caused by the fungus *Phaeocryptopus gaumanni*. Symptoms are usually evident in late winter and early spring and appear on one- or two-year-old needles. Affected needles appear yellow or mottled and gradually turn brown. They often have 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 (Figure 5). With the naked eye, these bands look like "dirt." The fruiting bodies are structures of the fungus that grow out of the stomates (Figure 6).

Figure 5. Black fruiting bodies visible in the white rows of stomates.

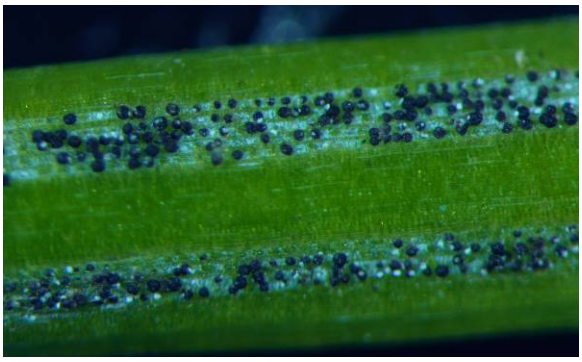

Figure 6. Close-up of fruiting bodies emerging from stomates.

Symptoms typically develop on 1st year needles prior to their 2nd year or on 2nd year needles prior to their 3rd 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 dropped or "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 feet or more above the ground and may kill trees.

Infection occurs in spring when spores are released from the fruiting bodies. Diseased needles can produce spores for one, two, or three seasons. Spores are disseminated by wind or splashing rain during shoot elongation in late spring and early summer. When spores land on the newly emerging needles, infection occurs. 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, non-pathogenic fungus. Sooty molds grow on the honeydew or excrement of insects such as scales, mealybugs, or aphids. 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.

MANAGEMENT STRATEGIES:

It is helpful to use healthy stock and maintain tree vigor with good weed control, proper fertilization (as determined by a soil test), and attention to planting site. Sanitation includes pruning and removing any dead or dying branches. It is often necessary to remove severely symptomatic trees to reduce the amount of inoculum. Since spores can be spread from tree to tree by tools, it is helpful to disinfest tools between cuts with household bleach (1 part bleach: 9 parts water), 70% alcohol, or one of the commercially available compounds such as Greenshield®. To reduce spread of disease, pruning should not be done when the foliage is wet.

The final strategy for disease control involves the proper selection, timing, and application of fungicide sprays. Thorough coverage of all parts of the tree is necessary. Among the compounds registered for use in Connecticut are chlorothalonil, chlorothalonil + fenarimol, and mancozeb. The labels contain information on dosage rates and safety precautions. Applications are made when new shoots are approximately 1-1½" long and again three weeks later. Additional applications may be necessary in years with excessive rainfall.

May 2010 (revised)