Cytospora Canker of True Firs

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Cytospora abietis, a fungus, causes a cankering and dieback disease, resulting in considerable damage to true firs (*Abies*) in Western United States. White Fir *(A. concolor)* and red fir *(A. magnifica)* are the tree species most commonly attacked in California, Nevada, and Oregon. In Idaho, grand fir *(A. grandis)* is the common host for this fungus, but this disease has been reported as a weak parasite of western larch *(Larix occidentalis)* in northern Idaho and western Montana. Douglas-fir *(Pseudotsuga menziesii)* along the Pacific coast occasionally is attacked by *C. abietis*. *C. abietis* is a less serious problem on true firs in the East.

Cytospora attacks trees of all ages. Small seedlings and saplings are often girdled and killed, whereas on larger trees, branch and top-killing is most common. In Idaho, the fungus occurs sporadically, causes a dieback of the terminal and upper branches of young firs, and is primarily a problem to producers of Christmas trees.

Predisposing Factors

Generally *Cytospora* is a weak parasite, but it can assume epidemic proportions when trees are injured, weakened, or predisposed to attack by adverse conditions. For example, in 1959–1960 and again in 1966 in some parts of California, trees were severely weakened by drought. Subsequently, the parasite intensified over several fairly large areas and killed limbs, tops, and even rather large trees. The disease subsided during subsequent years when there was adequate rainfall.

The increase in bark beetle populations, common during drought years, also may increase the incidence of this disease. Patch killing of bark by beetles and galleries produced by their larvae weaken branches and produce potential sites of infection.

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Fire aids attacks by *Cytospora*. Scorching of branches and twigs from ground fires damages and weakens trees and predisposes them to attack. Buildup of this disease has been observed in certain areas after severe fire years.

Firs growing on poor sites are more susceptible to infection than are trees on good sites. For example, the disease is more common and severe on firs growing on the poorer, dry sites on the east slope of the Sierra Nevada crest than on the better, more moist sites of the western slope.

The cytospora canker disease can build up in small red fir trees left after logging; severity of buildup appears related to the degree of logging damage to the residual stand. Skinned and damaged tops and branches are prime sites for infection. Also, understory firs often suffer shock from overstory removal, presumably as a result of sudden exposure to direct sunlight and increased temperature.

Dwarf mistletoe *(Arceuthobium abietinum)*, a serious parasite of true firs in California, also commonly predisposes both red and white fir to attack by *Cytospora*. Cytospora canker is commonly found on branches of red fir and white fir infected with dwarf mistletoe. Dwarf mistletoe swellings provide openings in the host bark for infection, and a favorable environment for growth and development of the fungus. In California, about 20 percent of the branches infected with dwarf mistletoe are invaded and eventually killed by *Cytospora*. As a result, the fungus exerts some biological control of dwarf mistletoe. But the reduction of a significant proportion of the living crown from branch dieback probably has a more adverse influence on tree growth than a favorable influence in reducing the amount of dwarf mistletoe.

The Fungus

Cytospora abietis is the imperfect stage of the fungus *Valsa abietis*. The perfect stage occurs in Europe, but has been reported only once in North America, on *Thuja occidentalis* in Iowa.

Development of the fruiting bodies takes place in the dead bark tissues. Spore production occurs in spring and summer, usually during periods of rain or high moisture.

Infection is by spores produced from the fruiting bodies imbedded in the bark of an infected branch. The spores are waterborne and spread during rains. Possibly the spores also are transmitted by bark beetles and other insects. Infection takes place through wounds and other openings in living branch tissues. Following infection, the fungus grows into and kills the cambium and inner bark. Growth of the fungus is about twice as fast longitudinally along a branch than it is around the branch circumference. Thus, elongated cankers often are produced. Eventually, however, usually in about 6 months to 2 years, the fungus girdles and kills most branches. Large branches and trunks are girdled more slowly.

Symptoms and Signs

Dying back or flagging of branches, tops, and small trees is the most notable symptom of infection by *Cytospora* (figs. 1, 2). Flags begin to appear in late spring and in early summer. They initially are brick red. Later in the summer and fall, the foliage of flagged branches turns light brown. For the most part, much of the dead foliage remains on flagged branches for at least a year after flagging and sometimes 2 to 3 years. Flagging is particularly noticeable in stands infected with dwarf mistletoe, especially during the spring following a year of subnormal precipitation.

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Figure 1.—Light colored branches indicate branch flagging of red fir caused by *Cytospora abietis*.

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Figure 2.—Top of this pole size white fir was killed by *Cytospora abietis*.

Cankers are often formed by this disease. Sunken cankers (fig. 3) are common, but cankers showing little sunken tissues do occur. Cutting the bark away from a suspected infection often will show the margin between living tissue and the canker. Some branches, usually small ones, are girdled and killed by the fungus with no canker development. In these cases where rapid killing of a branch occurs, the condition is commonly known as a "dieback." On small trees, infection of the trunk may occur through side branches. A dead branch or branch stub usually can be seen in the central region of a developing trunk canker.

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Figure 3.—A sunken canker has resulted from an attack by *Cytospora abietis* on a red fir branch infected by dwarf mistletoe.

The fruiting bodies are small, blister-like structures imbedded in the bark of a dead branch or in the dead tissues of a canker. They are quite small and not easily discernible, but are quite abundant and give the bark on the portion of the branch where they occur a warty appearance. When fruiting bodies mature, they produce spores in great abundance. These usually occur in "spore horns" (fig. 4). Spore horns look like small, curly, yellow threads arising from the blisters and consist of many spores held together by a sticky material. When spore horns are wet, the sticky material dissolves and the spores are dispersed in the water.

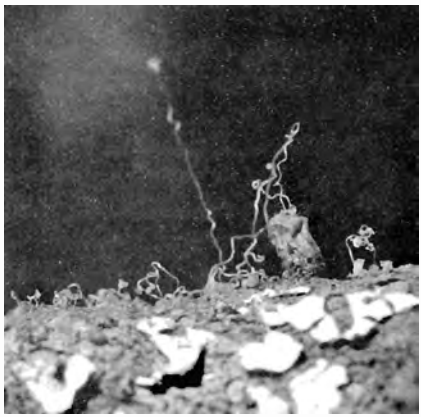

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Figure 4.—Spore horns emerge from the fruiting bodies of *Cytospora abietis* imbedded within the bark of red fir.

Resin or "pitch" often is exuded by branches infected by *Cytospora*. Resin exudation usually appears near the margin of the living and dead tissues. Old infections, generally on large branches and trunks, show a noticeable amount of resin accumulation on the dead bark surfaces as well as near the canker margin. Small branches or seedlings killed quickly by *Cytospora* may show no resin exudation.

Control

No direct control of cytospora canker is known but certain measures can be undertaken in many instances to reduce damage from this disease. Avoid activities that will weaken or damage trees. Take all measures possible to reduce damage to residual trees during logging operations. Not only do open wounds provide entrance courts for infection, but the weakening of trees through scarring, root damage, and soil com-

paction also predisposes them to attack by *Cytospora*.

Avoid sudden exposure of understory true firs to strong light and high temperature. Weakening of trees from sudden exposure, plus wounds caused by logging, can lead to severe buildup of this disease.

Dwarf mistletoe is a primary factor predisposing trees to infection by this fungus. Removal of dwarf mistletoe-infected trees can reduce the buildup of both dwarf mistletoe and cytospora canker infection in surrounding trees.

Avoid planting true firs on poor sites or on sites not suitable for the species. Where a choice exists, remove infected trees in thinning operations.

On recreation sites and high use areas more intensive measures may be undertaken to control this disease. Prune and dispose of infected branches to reduce the chance of repeated infection and buildup so that branch infections will not grow into the trunk. High value trees may be watered during dry periods to avoid weakening from drought. Also, shading small trees—particularly recently planted or exposed ones—for 1 to 2 years will protect them from shock from intense light and high temperatures.

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