

CHAPTER NINE

Upper Stem Canker

Philip B. Hamm

Disease and hosts

Upper stem canker is caused by the fungi *Phoma eupyrena* and *Fusarium roseum*. It has been reported only on 1+0 Douglas-fir seedlings. However, inoculation tests indicate that true firs, spruce, hemlock, and western larch are susceptible. This disease has been found in nearly every bareroot nursery in western Oregon and Washington. The fungi are present in nurseries outside this area, but the disease has been observed only in the Pacific Northwest.

Upper stem canker may be confused with:

- Frost damage**
- Gray mold**
- Mechanical damage**
- Pesticide damage**
- Phomopsis canker**

Symptoms

Seedling tops turn chlorotic and then reddish-brown above girdling cankers on the middle to upper stem (Figure 9-1). Cankers initially appear as sunken areas centered most often on a bark fissure, a wound on the stem that occurs naturally when the bark is expanding during periods of rapid growth (Figure 9-2). Less often the canker will be associated with a needle (Figure 9-3).

The canker turns reddish-brown as it expands around the stem. Light



Figure 9-1. This seedling was top-killed by a stem-girdling canker midway up the shoot.

scraping of the cortex clearly reveals the infected area. More than one canker may occur on a seedling. Cankers may elongate up the stem, but there is relatively little downward movement. Pycnidia, small black structures, may be present on the face of the canker (Figure 9-2).

Damage is first evident in mid-August to September of the first growing season. Symptoms of top kill generally continue to appear through November. However, seedlings infected late in the fall may not show symptoms until the following spring. Damage is often concentrated in distinct areas of the nursery, with seedlings in other areas remaining unaffected by the disease (Figure 9-4).



Figure 9-2. An infected bark fissure shows brown discoloration of the normally green stem and small black pycnidia forming in the center of the fissure.

Fungus biology

Phoma eupyrena and *Fusarium roseum* are common soil inhabitants and are associated with a number of other seedling diseases. They are commonly present on healthy seedlings. Primary inoculum probably comes from chlamydo-spores, thick-walled resting structures surviving in the residue of previous crops or weeds; or from conidia. *Phoma* conidia are small oval-shaped spores that form in small, black, globose pycnidia, whereas *Fusarium* conidia are sickle-shaped and are produced on the surface of the seedling. Conidia are produced in large quantities by both fungi and presumably act as secondary inoculum. Spores are brought into the nursery by contaminated equipment, seed, and soil,

including windblown soil. Infection of seedlings occurs when spores land in bark fissures. Needles are also occasionally infected. Infection occurs in late summer or fall, with damage first visible in mid-August.

Upper stem canker symptoms appear:

1+0

Late summer through late fall

Loss potential

Significant losses occur sporadically in Pacific Northwest forest nurseries. Millions of seedlings have been damaged by upper stem canker, particularly during the years 1980 through 1985, when as much as 3 to 4 percent of the 1+0 crop in the Pacific Northwest was infected annually. Losses have been less severe in recent years because cultural and chemical control has become more effective.

Although seedlings are usually not killed, they develop multiple stems, which may make them unacceptable to buyers. Also, infected seedlings may not regain



Figure 9-3. The canker is associated with the dead needle attached to the stem and the bark fissure.



Figure 9-4. Typical field symptoms of upper stem canker. Seedlings tops are killed, generally in distinct areas of the beds.

adequate height to make packing standards.

The amount of infection depends on whether seedlings are actively growing or dormant at the time favorable for infection, as well as the amount of rainfall at that time. Damage can be particularly heavy among succulent seedlings when 1+0 seedling growth continues into the fall. Cool, rainy conditions favor the dissemination and germination of the fungus, while slowing the callusing of bark fissures and thereby leaving wounds open for prolonged periods.

Management

CULTURAL

Cultural practices that force growth into the fall, such as fertilization and irrigation, should be avoided. Historically, high-density sowings have suffered greatest damage. Sowing seed less densely may effect some control.

CHEMICAL

The fungicides benomyl and chlorothalonil control upper stem canker when applied at 2-week intervals from mid-July to bud set in the fall. Applying them alternately in

rotation is recommended. More-frequent applications in the fall are necessary if heavy rains begin before buds set and bark fissures callus over.

Selected references

- Cooley, S.J.; Kanaskie, A. 1986. Evaluation of seven fungicides to control canker diseases of bareroot Douglas-fir in Pacific Northwest forest nurseries. Forest Pest Management Report R6-86-14. Portland, OR: U.S. Department of Agriculture, Forest Service. 23 p.
- Hamm, P.B.; Hansen, E.M.; Kanaskie, A.M. 1985. Symptomology of the "top blight" diseases of Douglas-fir bareroot seedlings in the Pacific Northwest (Abstract). *Phytopathology*. 75:1367.
- Hansen, E.M.; Hamm, P.B. 1988. Canker diseases of Douglas-fir seedlings in Oregon and Washington bareroot nurseries. *Canadian Journal of Forest Research*. 18:1053-1058.