

Stem Canker Diseases of Douglas-fir in Nurseries¹

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Abstract--Diseases that kill above ground portions of Douglas-fir formerly called "Top Blight," are listed. Disease recognition, time of infection, infection site, and causal agents are described.

"Top Blight" was a term coined in the early 1980's to describe death of aboveground portions of Douglas-fir in bare root nurseries in the Pacific Northwest. Because the damage was extensive, and the causal agents and times of infection were unknown, a research effort was undertaken with the support of the Industrial Forestry Association and Weyerhaeuser Company. Five distinct diseases were identified as part of this complex. They are, in their order of occurrence; *Fusarium* Hypocotyl rot, Upper stem canker, Lower stem canker, Phomopsis canker and Botrytus Canker (Hamm et al. 1985).

FUSARIUM HYPOCOTYL ROT

Mortality due to this disease appears in the 1+0 beds usually in July or August, generally associated with the first prolonged, hot weather of the summer (Fig. 1), and may continue through September or October. As the name implies, infection generally occurs in the hypocotyl region of the seedling but is not limited to that location. The causal agent, *Fusarium oxysporum* has also been seen attacking higher on the seedlings regardless of the point of infection, seedlings are quickly killed. Symptoms include stunting and chlorosis, leading to wilting and death. Dead and dying seedlings typically have a crooked top and tend to be randomly scattered throughout the nursery. *Fusarium* hypocotyl rot is the most damaging disease in Pacific Northwest nurseries at the present time.

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Fusarium oxysporum in the past has been best known for causing root rot of 1+0 Douglas-fir (Bloomberg & Lock, 1972). Field symptoms are quite like *Fusarium* hypocotyl rot. Individual symptoms, however, are markedly different and are easily differentiated at the early stages. Roots of *Fusarium* hypocotyl infected seedlings are healthy in contrast to rotted roots associated with *Fusarium* root rot. Observations seem to indicate *Fusarium* root rot is more likely to occur in nurseries which do not regularly fumigate sowing areas.

UPPER STEM CANKER

This disease occurs in the fall (Fig. 1) of the 1+0 year. Upper stem canker has been responsible for spectacular epidemics in Northwest bare root nurseries. *Phoma euphyrena* and *Fusarium roseum* are the causal agents. Diseased seedlings are usually not noticed until their tops die, with affected seedlings often concentrated in discrete areas in nursery beds. Close observations of individual seedlings will identify small sunken areas on the stem, called cankers, that are often red in color. The margin between healthy and diseased tissue is distinct but once the stem is girdled and the top begins to dry, the upper lesion boundary is no longer easily identified.

Infection most often is associated with bark fissuring on the stem, apparently a normal physiological response to rapid growth. Fissures expose the xylem and heal quickly under normal conditions. Conidia (spores) produced by these fungi by chance land in these wounds and cause infections. Top killing is more severe when weather favoring fast seedling growth in the fall suddenly became cool and moist, slowing wound healing while favoring fungal spore production and dissemination. Spore production has often been seen on infected bark fissures. Infection can also occur through needles and lateral branchlets.

Damage may be more apparent than real. Depending on the height of cankers on seedlings,

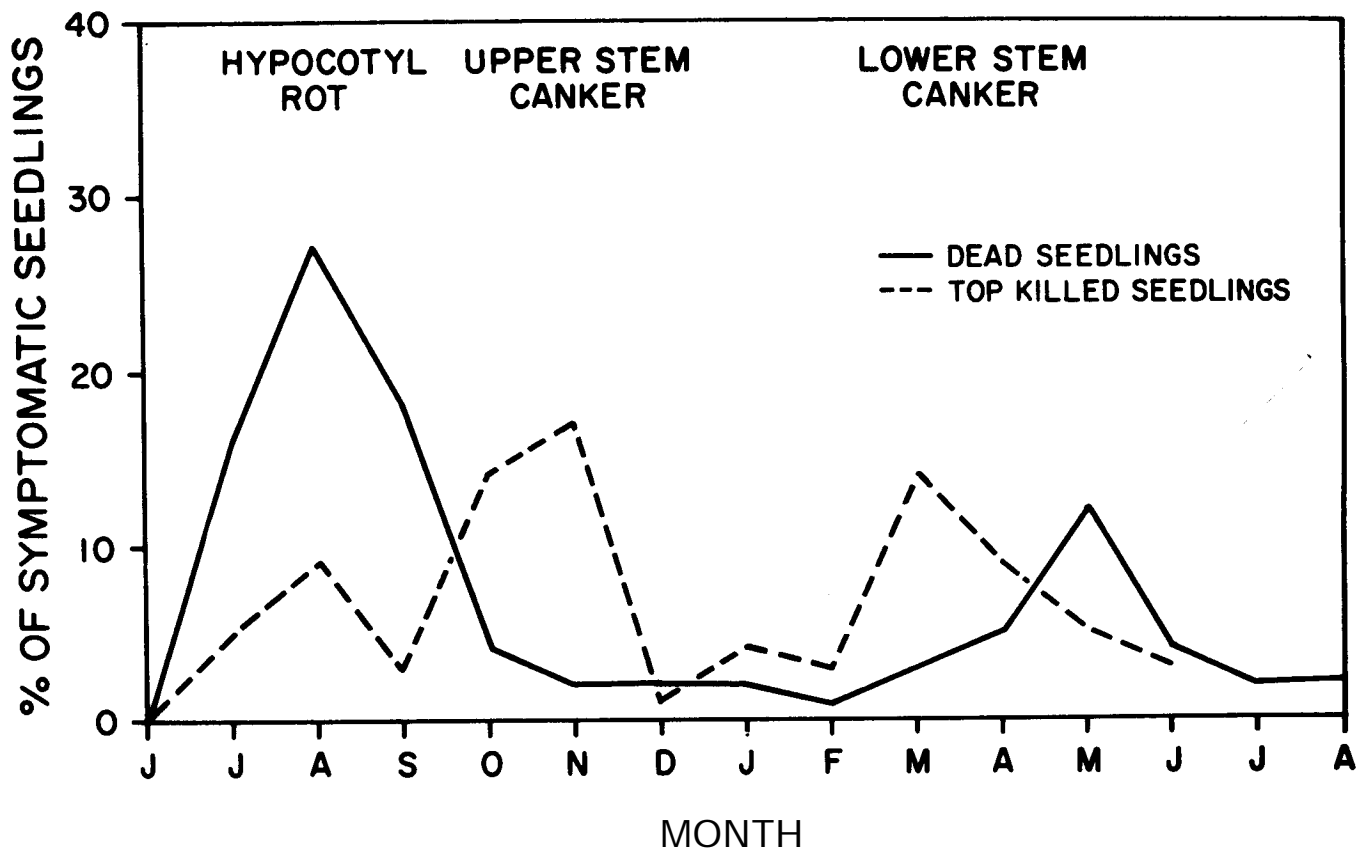


Figure 1. Chronology and symptom occurrence of three diseases affecting bare root Douglas-fir seedling in the Pacific Northwest.

the effect may be no more than early top pruning since cankers seldom expand downward. Loss is most likely to be due to seedlings failing to meet height packing standards.

LOWER STEM CANKER

The third disease identified was lower stem canker. This disease, also caused by *Fusarium roseum* and *Phoma eupyrena*, acting alone or together, attacks seedlings apparently sometime after dormancy in the fall and before growth begins in the 2+0 year (Fig. 1). Again a canker develops on the stem, but lower, usually at or near the soil line, and nearly always beneath the built up collar of soil that forms around the lower stem. Because cankers are typically found below the lowest branches, seedlings are killed. Infections probably occur on the stem through abrasion wounds caused by the freezing and thawing of soil, blowing soil, or through needles, needle scars, or lateral buds smothered by the soil collar. Mortality is concentrated in lower areas and therefore may be confused with *Phytophthora* root rot. Roots of seedlings recently killed by lower stem canker, however, are always healthy.

Two other diseases reported to attack above ground portions of Douglas-fir in Pacific Northwest Nurseries could be confused with lower stem canker; *Fusarium stem rot* (Morgan 1983) and *Phoma Blight* (Kliejunas et al. 1985). *Fusarium stem rot*, caused by *Fusarium roseum*, is apparently identical to lower stem canker, but in our experience both *Fusarium* and *Phoma* are involved. *Phoma* blight caused severe needle loss at a nursery in California but seldom girdled seedlings in contrast to lower stem canker. Those reports identify problems specific to individual nurseries. From a regional view, both *P. eupyrena* and *F. roseum* are capable of causing mortality.

BOTRYTIS AND PHOMOPSIS CANKER

The last two disease situations occur during the 2-0 growing season and is caused by two agents, *Botrytis cinerea* and *Phomopsis* sp. Each causes a canker, almost always on the new growth but generally at different locations or times. *Phomopsis* is usually isolated from cankers forming at the base of new growth; usually within 4-6 weeks after shoot elongation. *B. cinerea* infects generally higher on the new

Table 1. Canker Diseases of Douglas-fir seedlings in the Pacific Northwest.

Disease	Fungi	Season	Location	Entry
Fusarium Hypocotyl Rot	<u>Fusarium oxysporum</u>	1+0 Summer	Hypocotyl and above	Soil abrasions direct
Upper Stem Canker	<u>Phoma eupyrena</u> <u>Fusarium roseum</u>	1+0 Fall	Mid-upper stem	Bark fissures Needle scars Lateral branches
Lower Stem Canker	<u>Fusarium roseum</u> <u>Phoma eupyrena</u>	1+0 Winter Spring	Lower stem	Soil Collars Soil abrasions Dead needles
Phomopsis Canker	<u>Phomopsis</u> sp.	2-0 Summer	Base of new growth	Bud scales
Botrytis Canker	<u>Botrytis cinerea</u>	2-0 Summer	New shoots	Wounds, lateral branches

growth, often entering the stem through a lateral twig. Both fungi cause stem girdling but do not kill seedlings. Trees generally recover and make packing standards. Botrytis canker was more frequently seen in high density beds but overall, much less damage was caused by both of these organisms than by any other "top blight" disease.

A summary of the canker diseases of Douglas-fir seedlings, fungi involved, time of infection, and location of infection on the seedling as well as mode of entry is listed in table 1.

LITERATURE CITED

- Bloomberg, W.J. and W. Lock. 1972. Strain differences in Fusarium oxysporum causing diseases of Douglas-fir seedlings. *Phytopathology* 62:481-485
- Hamm, P.B., E.M. Hansen and A.M. Kanaskie. 1985. Symptomology of the "top blight" diseases of Douglas-fir bare root seedlings in nurseries in the Pacific Northwest. *Phytopathology* (Abstr.) 75:1367.
- Kliejunas, J.T., J.R. Allison, A.H. McCain, and R.S. Smith. 1985. Phoma Blight of fir and Douglas-fir seedlings in a California nursery. *Plant Disease* 69:773-775.
- Morgan, P. 1983. Fusarium Stem Rot of Douglasfir seedlings. *Plant Disease* 67:441-442.