Corky Root Disease Observed On Two Spruce Species and Western Hemlock

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A root disease of Douglas-fir[1] first observed in coastal British Columbia forest nurseries in 1963 (3), was described and named corky root by Bloomberg (1), in 1968. He implicated the nematode *Xiphinema bakeri* Williams and the fungus *Cylindrocarpon destructans (=C. radicicola)* as possible causal organisms. The disease, now prevalent in several coastal nurseries, ruined 700,000 Douglas-fir seedlings in 1969 (3). It was previously thought to be confined to Douglas-fir but has recently been observed on seedlings of Sitka spruce, white spruce and western hemlock[2] growing in *X. bakeri* infested nursery soil in experimental seedbeds at Victoria, and on hemlock, at the British Columbia Forest Service nursery at Duncan. It is described here because it has ruined 20 to 50 percent of the seedlings in these limited areas and is a potential threat elsewhere.

Corky root symptoms, similar on both spruce species (figs. 1 and 2), first become noticeable on randomly scattered seedlings during the midsummer-fall period of the first growing season. Shoot damage varies from severe stunting (epicotyl growth is decreased) and needle chlorosis to no appreciable effect when root damage is light. Bud formation is unaffected. Heavily damaged roots are short, lack laterals (or have malformed ones), appear dark and "corky", and often terminate in a swollen tip. Some root systems are only partially damaged, and shoots of these seedlings may appear normal.

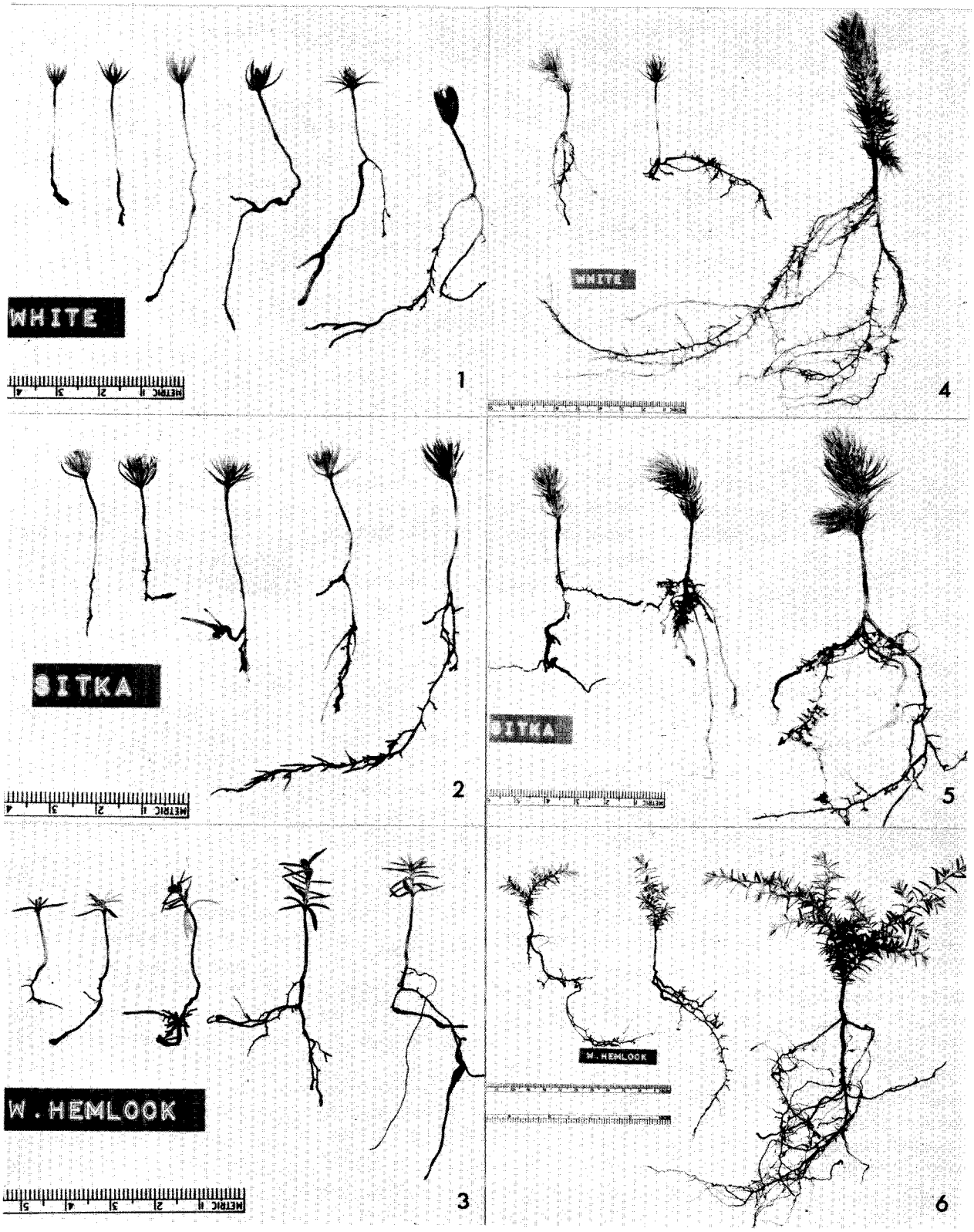
Timing, disease distribution in seedbeds, and symptoms of corky root on hemlock are much like those on spruce, i.e., shoot stunting and needle chlorosis, and stunting, malformation, darkening, and corky appearance of damaged roots (fig. 3). However, on hemlock, much more root damage is apparently necessary to cause chlorosis; some seedlings with severely damaged roots have needle chlorosis on only the lower third of the shoot. Because of the shallow, spreading nature of hemlock root systems, the roots in the upper 1 cm. of soil may escape the disease, probably because the nematode is absent there. There is no effect on bud formation.

Most damaged spruce and hemlock are frost-heaved during their first winter and early spring (4), accounting perhaps for disease scarcity in 2-0 stock. Survivors show some new root and shoot growth (figs. 4 to 6) in the spring and early summer when *X. bakeri* populations (which decline during the winter) are still low. However, recovery is insufficient to produce a plantable seedling. Isolations made from diseased 1-0 spruce and hemlock roots yield up to 50 *X. bakeri* nematodes per seedling; healthy seedlings have few or no nematodes. Although no attempt has been made to obtain the fungus *C. destructans* from 1-0 seedlings roots, it has been isolated from diseased roots of 2-0 and 3-0 spruce and hemlock. Assuming that the sequence of events is the same as for fir, the fungus would then only enter roots previously damaged *by X. bakeri (3).* Finding corky root on seedlings other than Douglas-fir was not unexpected because earlier studies (5) showed that such seedlings are good to excellent *X. bakeri* hosts. These observations suggest that there is little possibility of disease control by growing nonsusceptible seedlings on nematode-infested areas. Corky root can be controlled on Douglas-fir, and presumably on the other species, by preplanting application of D-D nematicide (2) and bare fallowing accompanied by frequent disking of nematode-infested areas during the hot, dry part of the summer (August and early September in coastal B.C.).

[1] *(Pseudotsuga menziesii* (Mirb) Franco.)

[2] Respectively, *(Picea sitchensis* (Bong.) Carr.); *(P. glauca* (Moench) Voss); and *(Tsuga heterophylla* (Raf.) Sarg.)

Figures 1 to 6.—Corky root disease on white and Sitka spruce and western hemlock (disease severity decreases from left to right). 1, 2, and 3—Symptoms at the end of the first growing season; 4, 5, and 6—symptoms at the early part of the second growing season; note partial recovery of shoots and roots.



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