DOUGLAS-FIR SEEDLING MORTALITY AT THE EARLY SELECTION TRIAL SITE, MONTANA STATE NURSERY, MISSOULA

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Containerized Douglas-fir (*Pseudotsuga menziesii* Franco) seedlings grown at the USDA Forest Service Nursery in Coeur d'Alene, Idaho, were outplanted in 1986 on a site at the Montana State Nursery in Missoula as an early selection trial in the Northern Region's tree improvement program. In the spring of 1987, several of the seedlings were dead or dying. Affected seedlings were in various stages of decline with both chlorotic and necrotic foliage. Some seedlings had necrotic foliage at their tops while the lower needles were mostly green (fig. 1). Such symptoms resembled those caused by winter drying (when the foliage above the snowline dries out because of excessive transpiration that cannot be replaced because the roots are in frozen soil). Other seedlings had their entire foliage necrotic (fig. 2). Roots of affected seedlings were not extensively decayed (fig. 3); however, they did not usually have actively growing root tips.

Figure 1. Containerized Douglas-fir seedling with necrotic foliage concentrated at the top of the seedling which may be indicative of winter drying.

Figure 2. Containerized Douglas-fir seedling with chlorotic and necrotic foliage 1 year following outplanting at the early selection trial site, Montana State Nursery, Missoula.

Figure 3. Roots of a declining Douglas-fir seedling outplanted at the early selection trial site, Montana State Nursery, Missoula.

Five seedlings in various stages of decline were selected at the site, carefully excavated, and taken to the laboratory for analysis. Roots of each seedling were washed thoroughly under running tap water for a few minutes to remove soil particles. Root systems were then dissected with a sterile knife into 2-4 mm pieces. Root pieces were surface sterilized in 10 percent aqueous sodium hypochlorite and rinsed in distilled water. Sixteen to 26 root pieces were randomly selected per seedling and placed directly on a selective medium for *Fusarium* spp. (Komada 1975) after surface sterilization.

Roots from all sampled seedlings were extensively colonized by *Fusarium oxysporum* Schlect (table 1). More than two-thirds of the randomly selected root pieces were colonized by this fungus. Two morphologically distinct isolates of *F. oxysporum* were isolated. No other *Fusarium* spp. were isolated from the roots. Other fungi isolated from roots included *Cylindrocarpon*, *Penicillium*, and *Trichoderma*, although none of these were found with the frequency of *F. oxysporum*.

Table 1.--Colonization of Douglas-fir seedling roots by selected fungi from the early selection trial site, Montana State Nursery, Missoula, Montana.

	Root Colonization 1/			
Seedling No.	*Fusarium oxysporum*	*Cylindrocarpon*	*Penicillium*	*Trichoderma*
1	62.5	56.3	0	0
2	71.4	42.9	28.6	0
3	73.9	0	43.5	0
4	73.9	0	0	0
5	61.5	0	7.7	19.2
All seedlings (av.)	68.8	16.5	16.5	4.6

1/ Percentage of randomly selected root pieces colonized by appropriate fungus.

Fusarium oxysporum commonly colonized roots of symptomatic seedlings and was probably important in the etiology of seedling decline and mortality. However, pathogenicity tests were not conducted to evaluate relative ability of isolates to incite disease. Roots of containerized Douglas-fir seedlings are often colonized by *Fusarium* spp. without production of disease symptoms (James et al. 1987). Also, several affected seedlings had symptoms similar to winter drying. Therefore, Fusarium root disease and winter drying may have both been responsible for seedling mortality at the early selection trial plantation.

LITERATURE CITED

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