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OCCURRENCE OF FUSARIUM ON THE ROOTS OF NONDISEASED BAREROOT DOUGLAS-FIR SEEDLINGS USDA FOREST SERVICE NURSERY, COEUR D'ALENE, IDAHO

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INTRODUCTION

Fusarium spp. cause important diseases on conifer seedlings in forest tree nurseries (Bloomberg 1981). In the northern Rocky Mountains, *Fusarium*-associated diseases are most damaging on containerized seedlings (James 1984, James et al. 1987), but losses occasionally occur in bareroot beds as well (James 1986b; James 1987).

One of the major problems in dealing with *Fusarium* diseases of conifer seedlings is detection of infected seedlings. By the time infected seedlings begin displaying above-ground disease symptoms, their roots are usually extensively colonized by these fungi (James 1986a). Random samples of containerized Douglas-fir (*Pseudotsuga menziesii* (Mirb.)Franco) and ponderosa pine (*Pinus ponderosa* Laws.) seedlings which appear healthy and nondiseased often indicate that many of these seedlings may have roots colonized by *Fusarium* (James et al. 1987; James and Gilligan 1988). Occurrence of fungi endophytically within conifer seed and seedlings without eliciting disease is common (Bloomberg 1966; Lewis 1924; Salisbury 1955; Vaartaja and Cram 1956). These organisms, including *Fusarium* spp. may become active and cause disease when environmental conditions are conducive for pathogenesis or host susceptibility increases as a result of stress.

Because of the common association between containerzed Douglas-fir seedlings and root colonization by *Fusarium* at the USDA Forest Service Nursery in Coeur d'Alene, Idaho (James et al. 1987), samples of bareroot 2-0 Douglas-fir seedlings were analyzed to determine if they too were colonized by these fungi.

MATERIALS AND METHODS

Three random samples of 2-0 bareroot Douglas-fir seedlings were collected during 1987 from the nursery (Table 1). Each sample consisted of 20 seedlings (five from each of four different areas). Seedlings were measured (height and caliper) and their oven-dry weight of above-ground portions was determined. Roots were washed thoroughly under running tap water to remove adhering soil particles. Roots were then surface sterilized in 10 percent aqueous sodium hypochlorite and rinsed in sterile distilled water. From each root system, ten lateral roots were randomly selected. Tips about 5 mm in length were aseptically cut from each selected root and placed on an agar medium selective for *Fusarium* (Komada 1975). Plates were incubated at about 25 degrees C for 7 days under a diurnal cycle of cool fluorescent light. Number of root tips colonized with *Fusarium* and *Trichoderma* spp. (common antagonists of *Fusarium* (Papivizas 1985) were determined. Representative isolates of *Fusarium* were transferred to potato dextrose agar and carnation leaf agar and identified to species using a standard taxonomic guide (Nelson et al. 1983). Standard "t" tests were conducted to compare height and oven-dry weights of seedlings infected with *Fusarium* and those not infected.

Table 1.--Colonization of roots of nondiseased bareroot Douglas-fir seedlings with *Fusarium* and *Trichoderma* - USDA Forest Service Nursery, Coeur d'Alene, Idaho.

		Fusarium infection		Trichoderma infection		Sample average		
Date of sample	No. seedlings sampled	Percent infected	Coloni-zation rate	Percent infected	Coloni-zation rate	Height (cm) [1]	Caliper (mm)	Oven-dry wt. [2]
5/87	20	30.	10.0	100.	91.5	15.5	2.2	1.03
8/87	20	30.	10.0	100.	97.0	15.1	3.6	1.57
10/87	20	35.	22.9	100.	99.5	15.0	4.2	1.96
Totals	60	31.7	14.7	100.	96.0	15.2	3.3	1.52

[1]Comparisons between *Fusarium*-infected seedlings and those not infected: $t = 0.58$ (not significant); $df = 58$.

[2]Comparisons between *Fusarium*-infected seedlings and those not infected: $t = 0.40$ (not significant); $df = 58$.

RESULTS AND DISCUSSION

Almost one-third of the seedlings sampled had roots that were infected with *Fusarium* despite having no disease symptoms (Table 1). However, individual root systems were infected at a very low level. Root infection was generally much less than that found in nondiseased containerized seedlings (James and Gilligan 1988). There were no statistical differences in either height or above-ground oven-dry weights between infected seedlings and those without *Fusarium* on their roots. This would indicate that the *Fusarium* present on roots was not affecting seedling growth.

In contrast to *Fusarium*, *Trichoderma* spp. were commonly isolated from the roots of nondiseased Douglas-fir seedlings. These latter organisms have been detected in the soil at the nursery at high levels, and are rapid recolonizers of fumigated soil (James and Gilligan 1985; James and Gilligan 1986). Their common presence on the roots of bareroot seedlings may be important in limiting the occurrence of *Fusarium* on the roots. *Trichoderma* spp. may be antagonistic toward root pathogenic fungi, including *Fusarium* spp. (Papavizas 1985). Inverse relationships between *Trichoderma* and *Fusarium* colonization of roots and seeds of coniferous seedlings have been found in earlier studies as well (James et al. 1987; James and Gilligan 1985).

The major species of *Fusarium* isolated from the roots of nondiseased Douglas-fir seedlings was *F. oxysporum* Schlect. This species is common on the roots of both diseased and nondiseased seedlings (James 1988; James and Gilligan 1988). Pathogenic strains of the species may occur along with strains that are nonpathogenic (James et al. 1988). The other species isolated was *F. acuminatum* Ell. & Ev.. This species likewise has been isolated from root-diseased and nondiseased seedlings (James 1988; James and Gilligan 1988). Tests have indicated that certain strains of this species may be quite pathogenic (James et al. 1988).

Problems of seedlings infected with *Fusarium* but not eliciting disease symptoms may not be of concern until seedlings are outplanted. In nurseries, seedlings are usually given sufficient nutrients and moisture so that they are not significantly stressed. Under such conditions, root infection by *Fusarium* may be of little consequence. However, when seedlings are outplanted, they may undergo both moisture and nutrient stress, particularly until their roots become completely mycorrhizal (Marx 1972). If *Fusarium* occurs on the root system, it may become active and cause disease under the stressful conditions of outplanting. Tests to evaluate the fate of *Fusarium* on nondiseased container Douglas-fir seedlings are in progress. It is possible that *Fusarium* may contribute to the death of seedlings following outplanting.

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