

ROOT DISEASE OF LIMBER PINE AND NORDMAN FIR
BAREROOT SEEDLINGS - FANTASY FARMS NURSERY, PECK, IDAHO

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Nursery Disease Notes #108

March 1990

During 1989 at the Fantasy Farms Nursery, Peck, Idaho, root disease of bareroot limber pine (*Pinus flexilis* E. James) and Nordman fir (*Abies nordmanniana* (Steven) Spach) seedlings was found concentrated within low, poorly-drained portions of seedbeds. Affected fir seedlings displayed typical root disease symptoms, i. e., their foliage was either chlorotic or necrotic with an overall wilted appearance. However, most of the limber pine seedlings in nearby seedbeds were only stunted and had little foliar chlorosis or necrosis.

Growers had noticed the disease in low portions of seedbeds and had sent soil samples for laboratory analysis of pathogens. Samples contained *Fusarium*, *Pythium* and *Phytophthora*, although fungal species were not identified.

Three limber pine seedlings with root decay but without foliar disease symptoms and two Nordman fir seedlings with foliar necrosis were analyzed for presence of potentially-pathogenic fungi on their roots. Root systems of all sampled seedlings were washed thoroughly to remove particles of soil. Tips of 10 randomly-selected roots were severed, surface sterilized for 1 minute in a 10% bleach solution (0.525% aqueous sodium hypochlorite) and rinsed with sterile water. Each tip was then bisected into two pieces (2-3mm in length). One piece was aseptically placed on an agar medium selective for *Fusarium* and related fungi (Komada 1975), while the other was placed on a selective medium for water molds (*Pythium* and *Phytophthora* spp.) composed of V-8 juice agar amended with pimaricin, rifamycin, ampicillin, and pentachloronitrobenzene. Plates of Komada's medium were incubated under diurnal cycles of cool, fluorescent light at about 26°C for 7-10 days. Plates of V-8 juice agar were incubated in the dark at about 24°C for 3 days. Fungi emerging from root tips were transferred to potato dextrose and/or carnation leaf agar for identification using several taxonomic guides (Booth 1966; Domsch and others 1980; Dorenbosch 1970; Nelson and others 1983).

Isolation results are summarized in Table 1. Roots of all sampled limber pine and Nordman fir seedlings were extensively colonized with *Fusarium oxysporum* Schlecht. Two of the limber pine

seedlings were also colonized with *F. acuminatum* Ell. & Ev. *Fusarium chlamydosporum* Wollenw. & Reinking was frequently isolated from the roots of two Nordman fir seedlings. *Fusarium oxysporum* and *F. acuminatum* are common associates of root disease of conifer seedlings (James and others 1989); *F. oxysporum* has previously been isolated from root diseased seedlings at the Fantasy Farms Nursery (James 1983, 1987). Although *F. chlamydosporum* was recently isolated from roots of diseased noble fir seedlings grown in containers (James 1989), this species is rarely associated with conifer seedlings.

Table 1. Colonization of roots of bareroot limber pine and Nordman fir seedlings with potentially-pathogenic fungi - Fantasy Farms Nursery, Peck, Idaho.

Percent Root Colonization¹

Species/ Seedling	<i>Fusarium</i> ²			<i>Cylindro- carpon</i>	<i>Phoma</i>	<i>Mortierella</i>
	FOXY	FACU	FCHL			
Limber pine						
1	80	0	0	0	0	10
2	80	10	0	0	0	10
3	80	20	0	10	10	10
Average	80	10	0	3	3	10
Nordman fir						
1	90	0	30	0	0	0
2	50	0	50	0	0	0
Average	70	0	40	0	0	0

¹ Percentage of root tips (10 sampled per seedling) colonized with appropriate fungi.

² *Fusarium* spp.: FOXY = *F. oxysporum*; FACU = *F. acuminatum*; FCHL = *F. chlamydosporum*; *Cylindrocarpon* sp. is *C. didymum*; *Phoma* sp. is *P. eupyrena*; *Mortierella* sp. is unidentified.

Other potentially-pathogenic fungi isolated from the roots of diseased limber pine and Nordman fir included *Cylindrocarpon didymum* (Hartig) Wollenw. and *Phoma eupyrena* Sacc. Both fungi have been implicated in diseases of conifer seedlings (Booth 1966; James 1988; James and Hamm 1985). *Phoma eupyrena* was previously found on diseased Mugo pine seedlings at the Fantasy Farms Nursery (James 1984). However, neither of these fungi were isolated at high enough frequencies to implicate them as major causes of disease.

Pythium or *Phytophthora* spp. were not isolated from the roots of diseased seedlings. *Mortierella* spp. were isolated infrequently from roots of limber pine on the selective V-8 juice agar medium. These fungi are common soil saprophytes and usually not associated with plant diseases (Domsch and others 1980).

Results from this evaluation implicate *Fusarium* spp. (primarily *F. oxysporum*) as the major causes of root disease of bareroot limber pine and Nordman fir seedlings at the Fantasy Farms Nursery. These fungi are common soil residents and often cause disease when their populations are high (Nelson and others 1983). They are especially virulent on seedlings which are stressed, such as those growing in poorly-drained portions of seedbeds where water accumulations reduce soil aeration and restrict root growth. Future damage can be reduced by sowing less susceptible species (such as other pine species) in areas of poor soil drainage and growing the more susceptible species (true firs and Douglas-fir) in better-drained areas. Fungal populations in the soil can be reduced by fumigation and spot treatments with fungicides.

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