ROOT DISEASE OF CONTAINER-GROWN PONDEROSA PINE SEEDLINGS POTLATCH NURSERY, LEWISTON, IDAHO

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During a visit to the Potlatch Nursery (Lewiston, Idaho) to examine the 1989 seedling crop, several scattered ponderosa pine (***Pinus ponderosa*** Laws.) seedlings were found that had foliar symptoms possibly indicative of root disease. The most consistent symptom was necrosis of needle tips; necrosis seemed to progress from the tips of needles in towards their base. Such symptoms have often been associated with root disease of pine seedlings (James 1987, 1988; James and Gilligan 1984). Therefore, four seedlings displaying needle tip dieback symptoms were analyzed for association with potential root disease fungi.

Seedlings with root disease symptoms were selected from within affected seedlots of ponderosa pine. Disease symptoms for these seedlings are described in Table 1. Several of the seedlings with needle tip dieback symptoms had no evidence of root deterioration or decay, i. e., epidermal tissues were not easily removed from the stele, roots were light brown rather than dark brown or black, and many root tips were white, indicating active growth. Roots were washed thoroughly under running tap water to remove adhering particles of growing media. Several pieces 3-5 mm long were cut from root systems; selected pieces were located mostly behind active growing tips. Root pieces were surface sterilized in a 10% bleach solution (0.525% aqueous sodium hypochlorite) for one minute, rinsed with sterile distilled water, and placed on an agar medium selective for ***Fusarium*** spp. and related root disease fungi (Komada 1975). Plates were incubated at about 26°C for 7-10 days under diurnal cycles of cool, fluorescent light. Emerging fungi were identified to genus using the taxonomic guide of Barnett and Hunter (1972). Selective isolates of ***Fusarium*** were transferred to potato dextrose and carnation leaf agar and identified to species using monographs of Gerlach and Nirenberg (1982) and Nelson and others (1983).

Table 1. Root disease symptom descriptions of container-grown ponderosa pine seedlings - Potlatch Nursery, Lewiston, Idaho.

Seedling No.	Stem Length[1]	Root Disease Symptoms
1.	137mm	- Lower 40% of the crown necrotic; entire needles in lower crown necrotic; upper crown green. - Root system healthy with no decay evident and numerous white root tips.
2.	143mm	- Upper 10% of the crown with needle tip necrosis extending from 1/3 to 1/2 down the length of needles. - Root system healthy with no decay evident and numerous white root tips.
3.	164mm	- Upper 10% of the crown with needle tip necrosis extending about 1/3 down the length of needles. - Root system healthy with no decay evident and numerous white root tips.
4.	61mm	- Entire crown necrotic; no live foliage remaining - Root system with extensive decay; most lateral roots decayed with epidermal tissues easily sloughed off.

[1] Length of stem from groundline to tip of terminal bud.

All four sampled seedlings had roots that were colonized with ***Fusarium acuminatum*** Ell. & Ev. (Table 2). Seedling #4, which had been killed (foliage completely necrotic and roots extensively decayed), was also colonized with ***F. scirpi*** Lambotte & Fautr. This latter species of ***Fusarium*** is uncommon on container-grown seedlings. Two other groups of fungi were also isolated: ***Trichoderma*** spp. from three of the seedlings and ***Penicillium*** sp. from seedling #4. Both groups of fungi are common saprophytes, frequently isolated from conifer seedling roots (James and Gilligan 1988); ***Trichoderma*** spp. may also be important as competitors and/or antagonists of root pathogenic fungi (Papavizas 1985).

From these results, it appears that the primary cause of container-grown ponderosa pine seedling disease at the Potlatch Nursery was root infection by ***F. acuminatum***. This fungal species has previously been associated with seed (James 1985, 1989) and seedling root (James and Gilligan 1988) infection of ponderosa pine. It may be pathogenic under controlled conditions (James and Gilligan 1984; James and others 1986) and is the most commonly isolated ***Fusarium*** species in some container operations (James and others 1989). ***Fusarium acuminatum*** may readily colonize roots of container-grown ponderosa pine seedlings without eliciting disease symptoms

Table 2. Fungal colonization of roots of container-grown ponderosa pine seedlings - Potlatch Nursery, Lewiston, Idaho[1].

	Fungi			
Seedling Number[2]	***Fusarium acuminatum***	***Fusarium scirpi***	***Trichoderma* spp.**	***Penicillium* sp.**
1	+(100)	-	-	-
2	+ (90)	-	+(10)	-
3	+ (10)	-	+(90)	-
4	+(100)	+(10)	+(20)	+(20)

[1] Within the table, + = recovered from that particular seedling; - = not recovered; numbers in parentheses are percent of root pieces (ten sampled per seedling) colonized with the particular fungus.

[2] See table 1 for seedling size and symptom descriptions.

(James and Gilligan 1988). In the present investigation, this species caused needle dieback symptoms, but did not noticeably deteriorate roots of most seedlings. Root decay likely occurred in advanced disease stages (seedling #4), but was not necessarily manifested earlier.

Since ***F. acuminatum*** is seedborne on ponderosa pine (James 1985, 1989) and commonly colonizes styroblock containers (James, Dumroese and Wenny 1988), future disease losses can be reduced by rinsing seed with running water for at least 48 hours and adequately sanitizing containers prior to sowing. Techniques to improve cleaning of styroblock containers including hot water (James and Woollen 1988) and chemical treatments, such as sodium metabisulfite, are currently being developed. Other approaches to improved disease control include sanitizing greenhouse interiors between seedling crops and removal of infected seedlings when found. Fungicides are generally ineffective when applied late in the crop cycle when root disease symptoms often become evident (James and others 1988). Therefore, best results usually occur by preventing disease rather than instituting therapeutic measures once disease becomes evident.

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