NURSERY DISEASE NOTES USDA FOREST SERVICE NORTHERN REGION

No. 123 July 1991

WILTING OF CONTAINER-GROWN WESTERN WHITE PINE SEEDLINGS USDA FOREST SERVICE NURSERY, COEUR D'ALENE

R. L. James
Plant Pathologist

Western white pine (*Pinus monticola* Doug.) is one of the most important conifer species grown at the USDA Forest Service Nursery in Coeur d'Alene, Idaho. Seedlings are especially valuable because current stock is derived from seed produced in tree improvement plantations. These plantations produce genetically superior seed that comes from parents with levels of resistance to white pine blister rust. As such, improved western white pine seed is limited, making it important to produce as many high quality seedlings as possible from the least amount of seed possible.

Several white pine seedlings looked unhealthy during extraction from containers in early 1991. Some seedlings had extensive necrotic foliage with only a few green needles (figure 1). Others had a few necrotic needles, with the green foliage somewhat chlorotic and many individual needles appearing twisted (figure 2). Previous experience with white pine seedlings at the nursery indicated that twisting of needles was often associated with deterioration of root systems resulting from infection with pathogenic fungi (James 1985, 1987). When feeder roots are destroyed by fungi, seedlings essentially wilt because water lost during transpiration and respiration cannot be replaced. Therefore, an evaluation was conducted to determine if root infection by potentially pathogenic fungi was primarily involved in production of wilting symptoms on recently-extracted container-grown white pine seedlings .In additon, affected foliage was evaluated for possible colonization by foliar pathogens.

Seven seedlings with different levels of wilting symptom severity were selected for evaluation. Roots of seedlings were initially examined microscopically to determine general condition and extent of decay. Roots were then washed thoroughly under running tap water to remove growing media. Root pieces approximately 2-3 mm in length were excised, surface sterilized for 1 min. in a 10% bleach solution (0.525% aqueous sodium hypochlorite), and rinsed in sterile water. From 11 to 15 root pieces were sampled per seedling; most were obtained from the tips of lateral roots. After surface sterization, root pieces were aseptically placed on an selective agar medium for *Fusarium* spp. and related fungi (Komada 1975). Plates were incubated under diurnal cycles of cool, fluorescent light at about 24 degrees Centigrade for 7-10 days. Selected fungi growing from root pieces were transferred to potato dextrose agar (PDA) and carnation leaf agar (CLA) for identification (Fisher and others 1982). Species of *Fusarium* were identified using taxonomic descriptions of Nelson and others (1983).

Figure 1. Severely-wilted container-grown western white pine seedling grown at the USDA Forest Service Nursery, Coeur d'Alene, Idaho.

Foliage from each evaluated seedling was washed under running tap water, blotted dry, and placed in a moist chamber to promote growth of colonizing fungi. After 5 days at 24 degrees Centigrade, selected emerging fungi were transferred to PDA for identification. Taxonomic descriptions by Domsch and others (1980) were used to classify these fungi.

Roots of sampled seedlings were extensively colonized with *Fusarium* spp (table 1). Root decay was evident on most seedlings, although many had root systems that did not appear extensively decayed. All seedlings had at least some of their root system colonized and more than 50 percent of the sampled root pieces were colonized with these fungi. The most commonly isolated species of *Fusarium* was *F. acuminatum* Ell. & Ev. Several seedlings were also infected with *F. proliferatum* (Matushima) Nirenberg. However, only one seedling was infected with the common nursery pathogen, *F. oxysporum* Schlecht. Other fungi commonly isolated included *Trichoderma*, *Penicillium*, and *Phoma* spp. All three are often isolated from the roots and rhizosphere of conifer seedlings and are usually considered saprophytic colonizers.

Figure 2. Container-grown western white pine seedling with mild wilt symptoms from the USDA Forest Service Nursery, Coeur d'Alene, Idaho.

Table 1. Colonization of roots from wilted western white pine seedlings at the USDA Forest Service Nursery, Coeur d'Alene, Idaho.

	Percent Colonization	
Fungus	**Seedlings**	**Root Systems[1]**
Fusarium acuminatum	71.4	42.9
Fusarium proliferatum	71.4	20.2
Fusarium oxysporum	14.3	3.6
All *Fusarium*	100.0	58.3
Trichoderma spp.	100.0	58.3
Penicillium spp.	71.4	17.9
Phoma spp.	57.1	9.5

[1]From 11 to 15 root pieces sampled from each of 7 seedlings with various levels of wilt symptom severity.

Foliage from all sampled seedlings was extensively colonized with *Botrytis cinerea* Pers. ex Fr. The fungus was sporulating profusely over the surface of necrotic and green foliage after incubation in moist chambers. An unidentified species of *Cladosporium* was located on the needles of one seedling. *Phoma* sp. was often colonizing needle sheaths on several seedlings.

The wilting symptoms of these white pine seedlings could have been caused by either foliar infection by *Botrytis cinerea* or root infection by at least three species of *Fusarium*. The most commonly isolated *Fusarium* spp. was *F. acuminatum*, which can commonly cause root diseases of container-grown seedlings (James and others 1989). However, little is known about the disease-causing ability of the other common *Fusarium* species isolated, *F. proliferatum*. Although commonly found on roots of conifer seedlings, it may be more saprophtyic than pathogenic. Only one seedling with wilt symptoms was infected with *F. oxysporum*, a species known to be an important pathogen of conifer seedlings (Bloomberg 1976). However, foliage from all affected seedlings was extensively colonized by *Botrytis cinerea*. This important nursery pathogen has been frequently encountered on several different species of container-grown seedlings at the nursery (James and others 1983). It is especially damaging toward the end of the growing season and after hardening processes (James 1984). *Botrytis* can also cause important losses during periods of seedling storage (James 1988, 1989).

In conclusion, it appears that the major cause of white pine seedling wilting was attack by *Botrytis* on seedlings with abnormally high levels of necrotic foliage from root infection by *Fusarium* spp. Seedlings stressed by root pathogenic fungi would probably have difficulty during periods of hardening-off when fertilizer regimes are changed and moisture restricted. Resulting stress manifests itself by production of some foliar necrosis. This necrotic foliage is an ideal substrate for infection by and proliferation of *Botrytis*.

To help reduce damage in the future, levels of stress on seedlings should be reduced by controlling root infection by *Fusarium* spp. Although *Botrytis* can usually be controlled with fungicides (James 1984), it may be difficult to significantly reduce infection levels if seedlings are sufficiently stressed by root disease. Therefore, the priority for reducing future damage should be to improve seedling quality by restricting root disease, thus making seedlings less susceptible to *Botrytis*.

LITERATURE CITED

Bloomberg, W. J. 1976. Distribution and pathogenicity of *Fusarium oxysporum* in a forest nursery soil. Phytopathology 66:1090-1092.

Domsch, K. H., W. Gams and T.-H. Anderson. 1980. Compendium of soil fungi. Academic Press, London. 859p.

Fisher, N. L., L. W. Burgess, T. A. Toussoun and P. E. Nelson. 1982. Carnation leaves as a substrate and for preserving cultures of *Fusarium*. Phytopathology 72:151-153.

James, R. L. 1984. Biology and management of Botrytis blight. *In*: Murphy, P. M. (compiler). The Challenge of Producing Native Plants for the Intermountain Area. Proceedings: Intermountain Forest and Range Exp. Sta., Gen. Tech. Rept. INT-168. pp. 39-43.

James, R. L. 1985. Decline of containerized western white pine seedlings at the USDA Forest Service Nursery, Coeur d'Alene, Idaho. USDA Forest Service, Forest Pest Management, Northern Region. Nursery Disease Notes No. 24. 4p.

James, R. L. 1987. Containerized western white pine seedling root disease-USDA Forest Service Nursery, Coeur d'Alene, Idaho. USDA Forest Service, Forest Pest Management, Northern Region. Nursery Disease Notes No. 66. 4p.

James, R. L. 1988. Storage mold of bareroot Douglas-fir seedlings. USDA Forest Service, Forest Pest Management, Northern Region. Nursery Disease Notes No. 72. 2p.

James, R. L. 1989. Storage mold of bareroot Douglas-fir seedlings - Swan Lake Ranger District, Flathead National Forest - 1989. USDA Forest Service, Forest Pest Management, Northern Region. Nursery Disease Notes No. 93. 4p.

James, R. L., R. K. Dumroese, C. J. Gilligan and D. L. Wenny. 1989. Pathogenicity of *Fusarium* isolates from Douglas-fir seed and container-grown seedlings. Idaho Forest, Wildlife and Range Exp. Sta. Bull. No. 52. 10p.

James, R. L., J. Y. Woo and P. L. Malone. 1983. Evaluation of fungicides to control Botrytis blight in western larch seedbeds at the Coeur d'Alene Nursery, Idaho. USDA Forest Service, Forest Pest Management, Northern Region. Rept. 83-6. 8p.

Komada, H. 1975. Development of a selective medium for quantitative isolation of *Fusarium oxysporum* from natural soil. Rev. Plant Prot. Res. 8:114-125.

Nelson, P. E., T. A. Toussoun and W. F. O. Marasas. 1983. *Fusarium* species. An illustrated manual for identification. The Pennsylvania State University Press, University Park. 193p.