

ROOT DISEASES OF TRANSPLANTED WESTERN WHITE PINE SEEDLINGS
AT THE USDA FOREST SERVICE NURSERY, COEUR D'ALENE, IDAHO

by

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ABSTRACT

Decline and mortality of transplanted western white pine seedlings at the USDA Forest Service Nursery, Coeur d'Alene, Idaho was probably due to root disease caused by Fusarium oxysporum, Cylindrocarpon sp. or Verticillium sp. Saprophytic organisms colonized the soil around roots; potential pathogens were only isolated from infected roots. Means of pathogen introduction into transplant beds were unknown, but they may have come in on infected nursery stock.

INTRODUCTION

During the fall of 1984, decline and mortality of transplanted western white pine (Pinus monticola Dougl.) seedlings at the USDA Forest Service Nursery, Coeur d'Alene, Idaho were investigated. Seedlings were being grown for a progeny test to evaluate resistance to blister rust caused by Cronartium ribicola Fisch.; they were initially container-grown seedlings and had been in transplant beds for 3 growing seasons. Although some blister rust-associated mortality was evident, the major problem was gradual decline accompanied by reduced growth, chlorotic and necrotic foliage, and eventual seedling death. Symptoms were similar to those caused by root diseases.

MATERIALS AND METHODS

Roots of declining and recently killed seedlings were examined closely in the field and five seedlings at various stages of decline were transported to the laboratory for further evaluation and isolation of associated fungi. Soil adhering to root systems was carefully filtered through filter paper (#1 Whatman) and 10 ml of the filtrate were placed on each of three plates containing a selective medium for Fusarium (Komada 1975). Inoculated plates were incubated under cool fluorescent light for 7-10 days at about 22°C and fungi identified. Root tips were aseptically cut from (1) the original containerized plug of roots and (2) the egressed lateral roots that arose from the plug. At least 15 root tips were sampled from each type of root system and incubated on Komada's medium as described above. Occurrence of selected fungi on root tips was tallied.

RESULTS AND DISCUSSION

Descriptions of the five seedlings selected for extensive root sampling are outlined in table 1. Soil filtrates only yielded saprophytic fungi in the genera Trichoderma, Penicillium, and Aspergillus. Isolations from root tips yielded Fusarium oxysporum Schlect. from two of the seedlings with severe disease symptoms (table 2). On these two seedlings the fungus was isolated from both plug roots and lateral roots. Another potentially pathogenic fungus isolated from sampled seedlings was Cylindrocarpon sp., which was found on all seedlings. This fungus has frequently been isolated from diseased containerized seedlings (James 1985; James and Gilligan 1985), however, pathogenicity on conifer seedlings has not been demonstrated.

Table 1.--Description of transplanted western white pine seedlings sampled for root fungi at the USDA Forest Service Nursery, Coeur d'Alene, Idaho.

Seedling No. 1

- foliage red, mostly necrotic.
- moderate lateral root egress from plug.
- wood mostly resin-impregnated from the roots upward.
- mycorrhizal development not extensive on lateral roots.

Seedling No. 2

- foliage mostly green with older needles becoming chlorotic; slight twisting of needles (incipient wilt); some needles with purple tips.
- extensive lateral root egress from plug.
- mycorrhizal development extensive on lateral roots.

Seedling No. 3.

- foliage brown; extensive twisting of needles (advanced wilt).
- moderate lateral root egress from plug; especially near root collar; little root egress from bottom of plug.
- mycorrhizal development not extensive.

Seedling No. 4.

- foliage red, mostly necrotic; extensive twisting of needles (advanced wilt).
- little lateral root egress; extensive root decay, especially at the bottom of the plug.
- no mycorrhizal development.

Seedling No. 5.

- foliage green; no chlorosis or necrosis, although seedling was dwarfed.
- extensive lateral root egress from plug.
- mycorrhizal development not extensive on roots.

Occurrence of the common soil-borne pathogen F. oxysporum on the roots of dead and dying white pine seedlings probably indicates that the fungus was at least partially responsible for the disease. Since this fungus has frequently been isolated from containerized white pine seedlings displaying wilt symptoms (James 1985), it is likely that F. oxysporum was involved. One sampled seedling with advanced decline symptoms from which F. oxysporum was not obtained (#3) had extensive root colonization by Verticillium sp. This fungus may have been a pathogen, although it is usually associated with wilt diseases of hardwoods in nurseries rather than conifer seedlings (Pearce and Gibbs 1981).

Table 2.--Ocurrance of fungi on root tips of transplanted western white pine seedlings at the¹USDA Forest Service Nursery, Coeur d'Alene, Idaho.¹

Seedling no.	Plug roots ²				Lateral roots ³			
	F. oxy.	Cyl.	Tri.	Other	F. oxy.	Cyl.	Tri.	Other
1	20	0	100	0	20	47	47	0
2	0	0	100	60 ⁴	0	13	80	7 ⁵
3	40	0	93	7 ⁴	20	7	93	0
4	0	7	67	60 ⁶	0	0	100	0
5	0	80	100	0	0	7	47	33 ⁶

¹Figures in table are percentage of sampled root tips (15 tips per root type per seedling).

²Roots produced originally within the container.

³Roots which had egressed from the plug roots.

⁴Aspergillus sp.

⁵Penicillium sp.

⁶Verticillium sp.

White pine seedlings were transplanted into soil that had previously been fumigated with methyl bromide/chloropicrin. Pathogen inoculum may have reinvaded transplant beds during the 3 years of seedling growth, or may have infected seedlings prior to transplanting. Although F. oxysporum was frequently isolated from the roots of declining containerized white pine seedlings (James 1985), the fungus may have been present on root systems of seedlings lacking symptoms. Previous work (Bloomberg 1966) indicates that this fungus readily colonizes conifer roots, often without causing disease symptoms. If infected white pine seedlings were transplanted into fumigated soil, pathogen colonization could theoretically proliferate because of absence of competing soil organisms.

CONCLUSIONS

1. Decline and mortality of transplanted white pine seedlings was probably due to root diseases incited by any or all of the following fungi: F. oxysporum, Cylindrocarpon sp., and Verticillium sp.

2. Although transplant beds were fumigated, pathogen inoculum either reinvaded the beds from surrounding areas or was introduced on infected containerized seedlings.

3. Additional work is needed to evaluate the occurrence of potentially pathogenic fungi on roots of healthy-appearing white pine seedlings and elucidate factors which might cause such fungi to initiate disease.

LITERATURE CITED

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