

## CONTAINERIZED GRAND FIR SEEDLING MORTALITY - NORTH WOODS NURSERY, ELK RIVER, IDAHO

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October 1987

Nursery Disease Notes No. 58

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Recent investigations were conducted to evaluate mortality of containerized grand fir (*Abies grandis* (Dougl.) Lindl.) seedlings being grown at the North Woods Nursery in Elk River, Idaho. Affected seedlings had foliage that had turned grey in color and appeared water soaked (figure 1). Foliage symptoms developed first at the base of seedlings and then extended upward throughout the crown. On several seedlings, white-orange sporodochia (fungal structures that produce spores) were found just above the groundline on the main stem (figure 2). These sporodochia were reminiscent of those produced by *Fusarium* spp., common pathogens of containerized seedlings.



Figure 1.--Containerized grand fir seedling with foliage symptoms resulting from root infection by *Fusarium avenaceum* at the North Woods Nursery, Elk River, Idaho. Foliage initially appeared grey and water soaked and later turned brown.

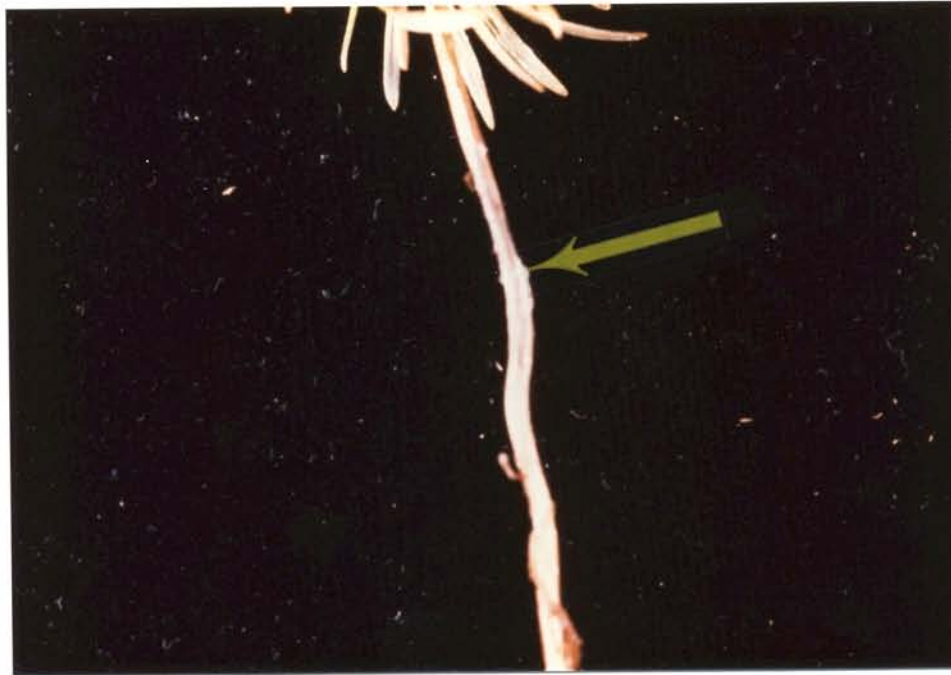


Figure 2.--Sporodochia (arrow) of *Fusarium avenaceum* on the main stem of a diseased grand fir seedling from the North Woods Nursery.

Six seedlings with moderate to severe disease symptoms were collected for analysis. Seedlings were rated for severity of symptoms using a seven-class rating system that had been developed for Douglas-fir seedlings (table 1). They were then aseptically dissected so that 11-15 root pieces and 5-6 stem pieces were obtained. These pieces were placed on a selective medium for *Fusarium* (Komada 1975) and incubated at about 22 degrees C for 7 days under cool fluorescent light. Number of pieces colonized with *Fusarium* spp. were determined and identification of associated fusaria was made.

Twenty-seven nongerminated seed were also collected from the surfaces of affected containers. Likewise, 15 seedcoats that had been discarded by seedlings after germination were also collected. Seed and seedcoats were placed on the selective *Fusarium* medium and incubated as described above.

Isolation results are summarized in table 2. More stem tissue was colonized with *Fusarium* spp. than root tissue. Many of the roots appeared healthy; most decay was evident within stem tissues or on roots near the root collar. Apparently the fungus attacked most seedlings at or immediately below the groundline rather than initially on the fine root tips as often happens with Douglas-fir seedlings (James 1984). More than 60 percent of the nongerminated seed that were sampled were infected with *Fusarium* spp. Also, most of the discarded seedcoats were likewise colonized.

The major organism consistently isolated from diseased seed and seedlings was *F. acuminatum* Ell. & Ev. This species has been previously associated with diseased conifer seedlings shown to be pathogenic (James and Gilligan 1984; James et al. 1986; James et al. 1987). It is interesting that *F. oxysporum* was not isolated from any of the sampled material. This species has most commonly been associated with conifer seedling diseases in the past (James 1986).

**Table 1.--Fusarium root disease rating system**

Rating	Description
0	No symptoms; seedling crown entirely green.
1	Seedling with slight needle tip dieback, particularly concentrated on the upper whorls of needles.
2	Seedling with lower whorl of needles partially or completely necrotic; seedling upright.
3	Seedling with needle tip dieback affecting at least one-half of the crown.
4	Seedling with one-half of its crown with necrotic foliage (upper or lower); seedling upright.
5	Seedling with one-half of its crown with necrotic foliage (upper or lower); seedling bent over.
6	Seedling with three-fourths of its crown with necrotic foliage; seedling may be upright or bent over.
7	Seedling with its entire crown necrotic; seedling may be upright or bent over.

**Table 2.--Results of isolations from diseased seedlings, nongerminated seed, and diseased seedcoats of containerized grand fir at the North Woods Nursery, Elk River, Idaho**

Seedling No.	Root disease rating*	Percent of colonization with <i>Fusarium</i>	
		Stem	Roots
1	6	100.0	86.7
2	6	83.3	33.3
3	5	100.0	53.3
4	4	100.0	73.3
5	7	100.0	50.0
6	7	100.0	100.0
Totals	-	96.9	65.1

Nongerminated seed:  
 No. sampled 27  
 No. with *Fusarium* 17  
 Percent infected 63

Discarded seedcoats:  
 No. sampled 15  
 No. with *Fusarium* 9  
 Percent infected 60

\*See table 1 for descriptions of root disease ratings.

It is likely that seedborne *F. acuminatum* was the cause of grand fir seedling mortality at the North Woods Nursery. *Fusarium* root disease is difficult to control with fungicides once it has become established; the most efficient way to reduce losses is to prevent infection by using clean seed. Several options to reduce amounts of *Fusarium* on seed have previously been outlined (James 1986; James 1987). These procedures coupled with maintenance of clean greenhouses should reduce future losses from this disease.

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