MORTALITY OF WHITE FIR SEEDLINGS AT THE FANTASY FARMS NURSERY, PECK, IDAHO

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Bareroot 2-0 white fir (Abies concolor (Gord. & Glend.) Lindl.) seedlings at the Fantasy Farms Nursery near Peck, Idaho were examined to determine possible causes of mortality. Affected seedlings were usually grouped within seedbeds (figure 1). Recently killed seedlings had reddish-brown foliage and were often adjacent to slightly chlorotic seedlings. Patterns of mortality within seedbeds indicated that root diseases might be responsible.

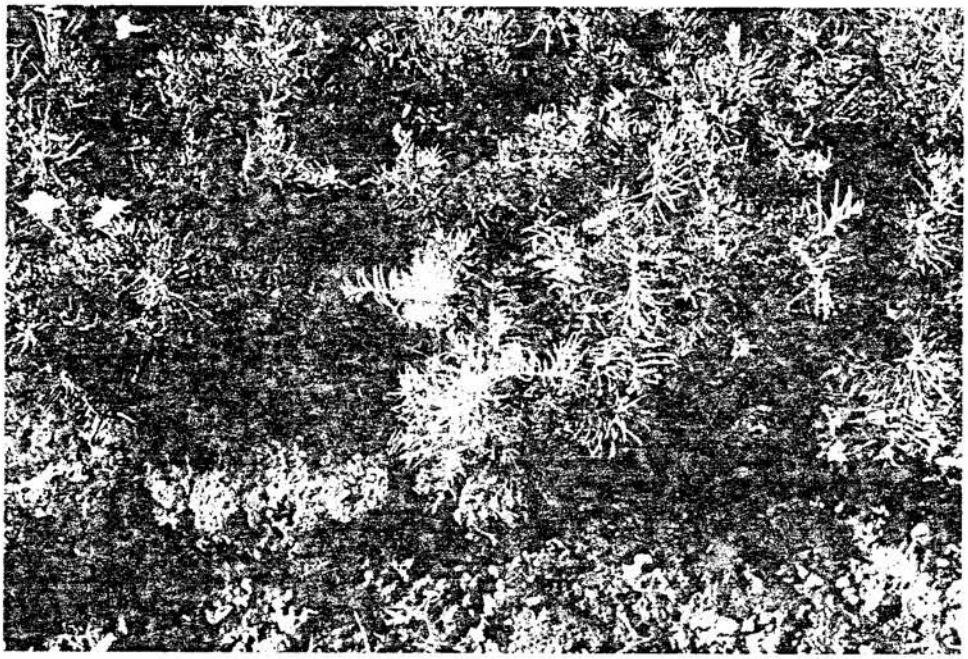

Figure 1.--White fir seedling mortality at the Fantasy Farms Nursery. Killed seedlings were mostly grouped within seedbeds.

Recently killed seedlings and those with chlorotic foliage were taken to the laboratory for analysis. Seedlings with slightly chlorotic foliage had mostly healthy root systems (figure 2). On the other hand, root systems from red seedlings lacked most lateral feeder roots with the tap root being mostly necrotic (figure 3).

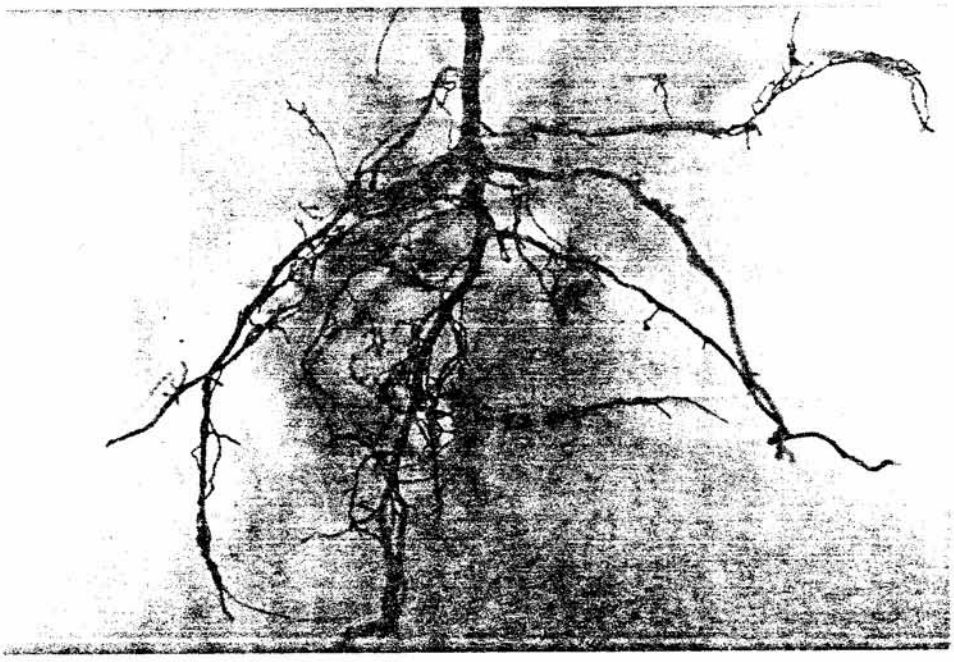

Figure 2.--Root system of 2-0 white fir seedling with slightly chlorotic foliage. Most lateral and feeder roots are intact and healthy.

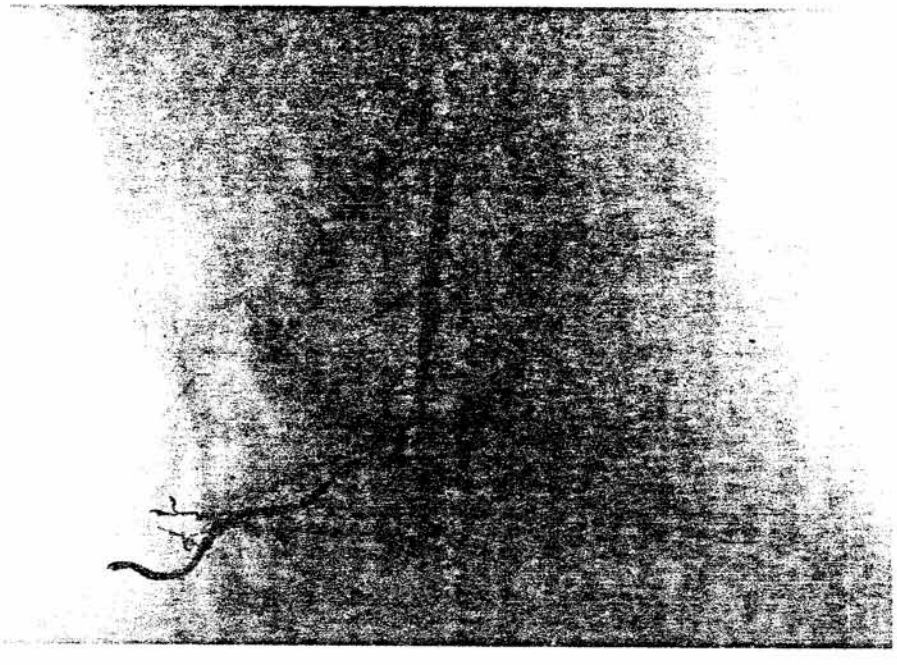

Figure 3.--Root system of 2-0 white fir seedling with reddish-brown foliage. Most lateral and feeder roots are missing and the tap root is necrotic.

Samples of roots from chlorotic and recently killed seedlings were surface sterilized with 10 percent sodium hypochlorite for 1 minute and asceptically placed on selective media for Fusarium (developed by Nash and Snyder (1962) and Pythium (developed by Hendrix and Kuhlman (1965) and standard 2 percent water agar (WA). Selective media made it easier to isolate species of Fusarium and Pythium, common soilborne pathogens. Fusarium and WA plates were incubated at 25° C under continuous cool fluorescent light and Pythium plates were incubated at 24° C in the dark. Fungi emerging from root samples were transferred to potato dextrose agar slants and identified.

Fusarium oxysporum Schlecht., a common pathogen of conifer nurseries, was isolated from most root samples of both chlorotic and recently killed seedlings. Distinguishing characteristics of this fungus included production of both macroconidia and microconidia (figure 4), chlamydospores (figure 5), and small, mostly unbranched microconidiosphores. At least six different isolates of F. oxysporum were obtained. Differences among the isolates included sporodochial color and production, macroconidia-microconidia ratio, rate of chlamydospore production, and general colony morphology including pigment production.

Although several other fungi, including Penicillium, Trichoderma, and Alternaria, were isolated from roots, these fungi are not likely pathogens. Pythium was not isolated from any of the root samples. Therefore, it is suspected that F. oxysporum is the cause of white fir seedling mortality. However, inoculation tests to confirm pathogenicity of the isolates obtained should be done to determine if F. oxysporum caused this disease.

Fusarium oxysporum is a soil-inhabiting fungus that is pathogenic to many different hosts, including most coniferous species. When it is not colonizing host substrates, the fungus resides in soil as resting spores called chlamydospores. The fungus becomes active only when a root tip of a host plant contacts or grows close to the mycelium or resting spores. The fungus may then invade root cells. Invasion rate depends on factors such as stage of host development at the time of initial infection, pathogen virulence, and climatic conditions. It has been shown that F. oxysporum can be inactive within roots for along time. However, after the fungus becomes active, mortality usually occurs. Chlamydopores usually form within host tissues after seedling death.

Fusarium oxysporum is a high temperature fungus that grows most rapidly during periods of high soil moisture and temperature. The fungus may produce sporodochia just above the ground line on stems of infected seedlings; spores are disseminated by wind and water to nearby seedlings. Infection centers are probably due to concentrations of high Fusarium inoculum in the soil and localized spread of the disease from infected seedlings. Populations of F. oxysporum within soil often increases under conditions of continuous cropping with susceptible hosts.

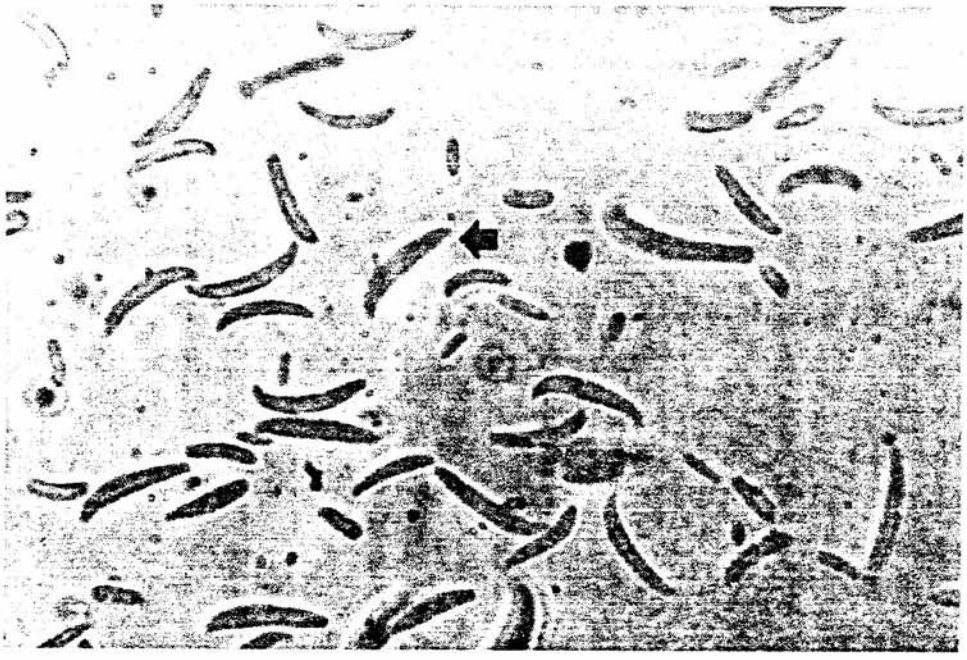

Figure 4.--Macroconidia (black arrow) and microconidia (red arrow) of Fusarium oxysporum isolated from roots of white fir seedlings (X450). Macroconidia are falcate, 2-3 septate, with distinctive foot cells. Microconidia are mostly oval and one-celled.

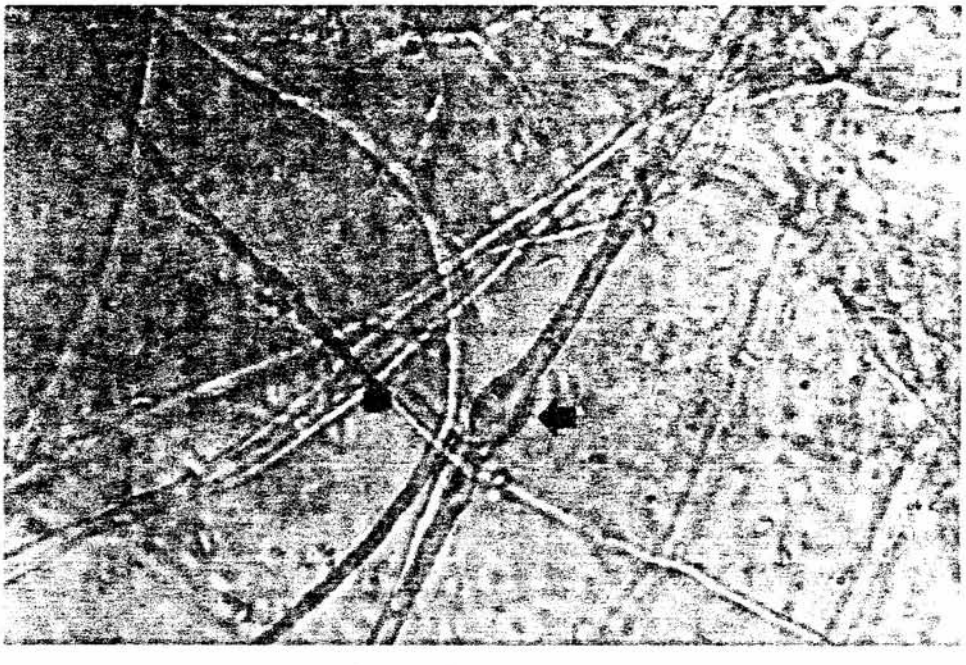

Figure 5.--Chlamydospore (arrow) of Fusarium oxysporum isolated from roots of white fir seedlings (X450).

It is suspected that much infection of the white fir seedlings at Fantasy Farms occurred during the first growing season. However, noticeable mortality was not evident until the second growing season. This may have been due to stress of infected seedlings caused by increased stocking density that resulted in infections becoming active.

Fusarium can be eliminated from soil by fumigation with chemicals such as methyl bromide and chloropicrin. Use of other volatile fumigants such as Mylone® and Vapam® have been less effective in reducing soil populations. Mixed results have been obtained in reducing disease incidence with fungicide applied as drenches to seedbeds. For example, Derr (1955) found that one or more post-emergence application of Tersan® effectively controlled the disease. However, Cooley (1983) reported that applications of captan, benomyl, and Banrot® did not consistently reduce losses.

Since certain seedlots appear more susceptible to the disease than others, identification of the more resistant seedlots may be useful. Also, seedbeds where the disease is most damaging can be allowed to lie fallow for a year without a cover crop. This will help reduce populations of F. oxysporum in the soil and should result in fewer future losses from the disease.

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