

Fusarium Root Rot of Douglas-Fir and Fraser Fir Seedlings in Pennsylvania

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ABSTRACT

Merrill, W., McCall, K., and Zang, L. 1981. *Fusarium* root rot of Douglas-fir and Fraser fir seedlings in Pennsylvania. *Plant Disease* 65:913-914.

Root rot of Douglas-fir and Fraser fir seedlings caused by *Fusarium solani* and of Douglas-fir seedlings caused by *F. oxysporum* is reported from Pennsylvania. During their second growing season, Douglas-fir nursery seedlings became stunted and chlorotic, wilted, and died. Mortality was about 50% in four nurseries; another 25-50% of the remaining seedlings were stunted, had poorly developed root systems, and probably would not have survived outplanting. In one nursery, more than 90% of the Douglas-fir seedlings died late in their first growing season. In a single seedbed of Fraser fir next to a severely affected Douglas-fir seedbed, 15% of the second year seedlings died; *F. solani* was recovered from roots with cortical root rot.

In 1976 a nursery in Schuylkill County, PA, incurred severe losses in Douglas-fir (*Pseudotsuga menziesii*) seedbeds sown in May 1975. During the second growing season, stems of about 75% of the seedlings failed to elongate. The affected seedlings turned chlorotic in June and July, and about 50% wilted and died in August. Tap roots and the few secondary roots on these seedlings had a cortical root rot. About half of the remaining seedlings were stunted, lacked secondary roots, and had sparse mycorrhizal development. Patches of healthy seedlings in the affected beds had normal growth and color, well-developed secondary roots, and moderate mycorrhizal development. This syndrome resembled that described for root rot in nurseries in the Pacific Northwest caused by *Fusarium oxysporum* Schl. (1-3). Isolations from the surface-disinfested roots of affected plants yielded colonies of *F. solani* (Mart.) App. & Wr. emend. Snyder & Hans. on Nash's medium (4). Various saprophytic fungi, such as species of *Trichoderma*, *Penicillium*, and *Alternaria*, were isolated on Nash's and other media.

In the summer of 1977, a similar disease problem developed in a nursery in Centre County, PA. These diseased seedlings also yielded *F. solani*. In the spring and summer of 1978, the same

disease syndrome developed in experimental progeny being studied by geneticists in the School of Forest Resources, Pennsylvania State University. Mortality ranged from 35 to 50% in some plantings. Isolations again yielded *F. solani*.

In October 1979, this disease syndrome occurred in nurseries in Tioga and Columbia counties, PA. Mortality was about 50% in both nurseries, and from 25 to 30% of the remaining seedlings were stunted, chlorotic, and had poorly developed root systems. Isolations from diseased seedlings from Tioga County

yielded *F. solani*. Isolations from seedlings from Columbia County yielded *F. oxysporum*. In addition, in the Tioga County nursery about 15% of the second-year seedlings of Fraser fir (*Abies fraseri*) in a seedbed immediately adjacent to an affected Douglas-fir seedbed showed similar symptoms. Isolations yielded *F. solani*.

In 1980 the disease recurred in the Tioga County nursery. About 50% of the second-year Douglas-fir seedlings died; about half of the remaining seedlings were stunted and chlorotic and had poorly developed secondary root systems. Surviving third-year seedlings in other beds still showed the effects of the disease, averaging 21 cm in height whereas patches of uninfected seedlings in the same bed averaged 41 cm (Fig. 1).

In 1980 the disease developed in another nursery in Schuylkill County. More than 90% of first-year Douglas-fir seedlings planted in early June turned chlorotic in late August and died by mid-September (Fig. 2). The remaining seedlings were chlorotic and had poorly developed root systems that exhibited

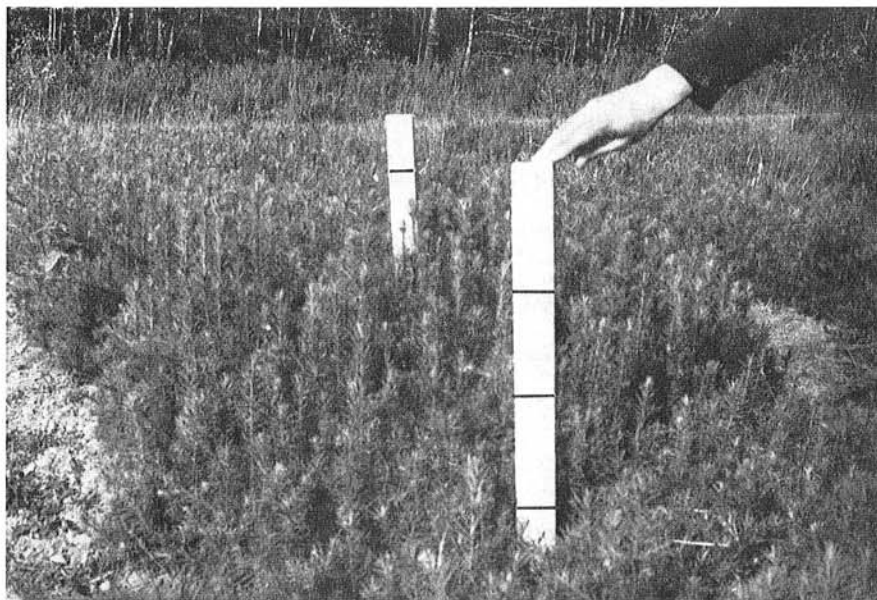


Fig. 1. Douglas-fir nursery seedbed, Tioga County, PA, planted in late May 1978 and photographed in October 1980. Seedlings in the foreground, which average 21 cm high, have root rot caused by *Fusarium solani*. Seedlings in the background, which average 41 cm high, have healthy root systems. The front stake is marked at 15.2, 30.5, and 45.7 cm; the rear stake is marked at 45.7 cm.

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Fig. 2. Douglas-fir nursery seedbed, Schuylkill County, PA, planted in early June 1980 and photographed in October 1980. Healthy beds usually contain about 1,500 seedlings per square meter. Residual seedlings were chlorotic and dying; the few secondary roots present had cortical root rot caused by *Fusarium solani*, *F. oxysporum*, or both.

cortical root rot. Isolations yielded both *F. solani* and *F. oxysporum*. About 50% of the second-year seedlings in this nursery were stunted, had sparse root systems with cortical root rot, and were dying in late September.

In October 1978, we surface sterilized Douglas-fir seeds in 1.0% sodium hypochlorite for 1 min, rinsed them in sterile distilled water, and planted them in twice-autoclaved peat:perlite (1:1) potting mix, one seed per pot. Seedlings emerged from January to March 1979 and were maintained in the greenhouse until December, given a 2-mo cold period, and then replaced in the greenhouse until the study ended in July 1980. Isolates of *F.*

solani were grown on potato-dextrose broth for 14 days, then homogenized for 0.5 sec in a blender. Ten milliliters of homogenate were added to each of half of the seedlings in March 1979. As seedlings died, we removed them from the pots and made isolations from the roots onto Nash's medium.

Although seedlings in nature usually developed symptoms during their second growing season, 7% of the inoculated first-year seedlings in this study became chlorotic and died. By July 1980, 27% (27 of 100) of the seedlings died. All dead plants had cortical root rot and all yielded cultures of *F. solani* on Nash's medium. None of the uninoculated seedlings died

or turned chlorotic. In a similar greenhouse study, an isolate of *F. oxysporum* caused 17% mortality of second-year Douglas-fir seedlings.

Although *F. solani* has long been known to cause damping-off of various coniferous species, this is the first report we know of that associates it with a cortical root rot of older seedlings. Since this paper was originally submitted, Sinclair and Hudler (5) have reported *F. oxysporum* associated with a similar syndrome on seedlings of Douglas-fir, red pine, and eastern white pine in New York. Their paper and ours are the first reports of the occurrence of *Fusarium* root rot on Douglas-fir seedlings in eastern nurseries, and ours is the first report of *Fusarium* root rot on Fraser fir. The disease appears to be common and widely distributed on Douglas-fir in Pennsylvania nurseries, and probably has been occurring for many years. In the past, growers in that state have attributed the problem to poor seed.

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