

Phytophthora Root Rot of Balsam Fir and Norway Spruce in North Carolina

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ABSTRACT

Kenerley, C. M., and Bruck, R. I. 1981. *Phytophthora* root rot of balsam fir and Norway spruce in North Carolina. *Plant Disease* 65:614-615.

Phytophthora cinnamomi incited a root rot of balsam fir and Norway spruce in nursery beds in western North Carolina. This represents the first report of *P. cinnamomi* on balsam fir and the first observation on Norway spruce in North Carolina. Virtually all conifer species grown in western North Carolina for the Christmas tree market are susceptible to this pathogen.

The two preferred conifer species grown in western North Carolina for the Christmas tree market have been Fraser fir (*Abies fraseri* (Pursh) Poir) and eastern white pine (*Pinus strobus* L.). *Phytophthora* root rot incited by *Phytophthora cinnamomi* Rands may result in serious losses in nursery beds or plantations with both of these species (2-4).

As a result of a severe seed shortage of Fraser fir, balsam fir (*Abies balsamea* (L.) Mill.) and Norway spruce (*Picea abies* (L.) Karst.) have recently been planted as alternative species. In September 1980, numerous small foci of dead and dying 1-yr-old Norway spruce and 3-yr-old balsam fir seedlings were found in a nursery bed on Wolf Mountain, Jackson County, North Carolina. The seedlings displayed decay of feeder and of lateral roots and needle chlorosis, necrosis, and drooping. These symptoms were similar to those seen on Fraser fir and eastern white pine infected with *P. cinnamomi* (2,3).

The objective of our research was to determine the etiology of root rot of balsam fir and Norway spruce.

MATERIALS AND METHODS

Symptomatic and asymptomatic balsam fir and Norway spruce seedlings were carefully removed from the nursery at Wolf Mountain, placed in plastic bags on ice, and transported to North Carolina State University.

Necrotic and slightly discolored roots were thoroughly washed under running tap water, surface-disinfested by soaking

in 0.5% sodium hypochlorite for 30-60 sec, rinsed three times in sterile water, and blotted dry with sterile filter paper. The disinfested roots were aseptically plated onto modified triple-P agar (pimaricin, 10 ppm; penicillin-G, 50 ppm; and polymixin B, 50 ppm) (1). Plates were incubated for 48 hr in continuous darkness at 20 C.

Healthy dormant 1-yr-old Norway

spruce and 3-yr-old balsam fir seedlings were removed from disease-free areas of the nursery bed, examined for necrotic or discolored roots, and individually placed into 8-cm diameter pots containing a 3:1 peat/vermiculite mix. Dormancy was broken by maintaining a 12-hr photoperiod (9 hr of sunlight supplemented by 3 hr of incandescent light) and a temperature of 20-25 C in the greenhouse.

Two methods of inoculation were used after seedlings initiated new shoot and root growth. In the first method, one-half of the contents of 1-wk-old petri plate culture of the fungus on cornmeal agar was triturated and the agar suspension dispensed into three holes (1 cm in diameter, 8 cm deep) around the base of each of 10 potted transplanted seedlings. In the second method, 5 g of a naturally

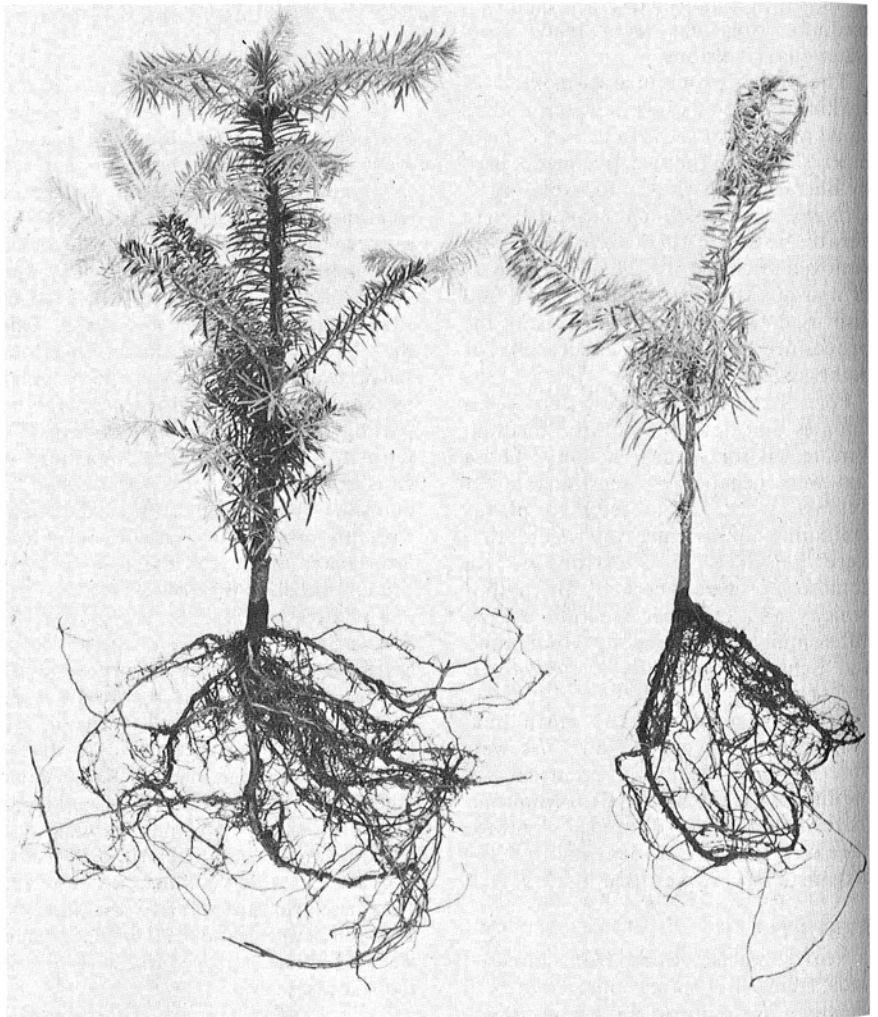


Fig. 1. Balsam fir: New shoot elongation and well-developed feeder system on healthy seedling (left). *Phytophthora* root rot with drooping terminal shoots and poorly developed necrotic roots on artificially infected seedling (right).

Paper 6820 of the Journal Series of the North Carolina Agricultural Research Service, Raleigh 27650.

Accepted for publication 19 May 1981.

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked "advertisement" in accordance with 18 U.S.C. § 1734 solely to indicate this fact.

infested soil (from N.C. Forest Service, Linville River Nursery, Crossnore, NC) containing 20 propagules of *P. cinnamomi* per gram of dry soil was similarly dispensed into pots containing a second group of 10 seedlings. Controls were 20 healthy seedlings treated with an uninfested agar suspension or 5 g of sterile soil.

RESULTS AND DISCUSSION

P. cinnamomi was isolated from 80% of symptomatic nursery seedlings. Inoculation of seedlings by either method resulted in death of 90% of the seedlings within 21 days. Controls remained asymptomatic and attempts to isolate the pathogen were unsuccessful. The first observable symptom was drooping of the current foliage flush, followed by reddening of previous year's needles at the base of the stem. Discoloration of needles progressed up the shoot and resulted in a mixture of brick red and

brown needles on both species within 3 days. Decay and discoloration of new and old root growth were apparent (Fig. 1). *P. cinnamomi* was readily reisolated from these roots.

P. cinnamomi is a pathogen of more than 900 species of plants worldwide (5). This represents the first report of this pathogen on balsam fir and the first observation on Norway spruce in North Carolina. Because *P. cinnamomi* can be introduced into a nursery easily (eg, contaminated equipment, boots, seedlings, tires) and moves rapidly within a nursery bed, this pathogen represents a serious threat to virtually all conifers grown for the Christmas tree market in western North Carolina. In addition, infected seedlings not exhibiting symptoms at field transplanting may later succumb to the pathogen during periods favorable for disease development. Such an occurrence results in further economic loss to growers and the infestation of

previously uninfested plantations. Management strategies to reduce the impact of *P. cinnamomi* on the Christmas tree industry in western North Carolina are under investigation.

ACKNOWLEDGMENTS

We gratefully thank D. M. Benson for identification of *Phytophthora cinnamomi* and Marvin Williams for photographic assistance.

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