Evaluation of Seedlings of Fraser, Momi, and Siberian Fir for Resistance to *Phytophthora cinnamomi*

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Abstract. Containerized seedlings of Fraser fir (*Abies fraseri* (Pursh) Poir.), momi fir (*A. Firma Sieb. & Zucc.), and Siberian fir (*A. siberica Ledeb. var. argentea*) were tested for resistance to *Phytophthora cinnamomi* Rands (two experiments). Fraser fir was very susceptible, with many plants dead after 4 to 5 weeks. Symptoms developed more slowly in Siberian fir, but most plants were dead or dying after 10 weeks. Momi fir appeared somewhat resistant to the pathogen. Though undesirable as a Christmas tree, momi fir might be useful as a rootstock for grafting better quality species in areas affected by root rot.

North Carolina ranks second nationally in Christmas trees produced, but possibly first in Christmas trees, rootstock, *Abies fraseri*, *Abies sibirica*, *Abies firma*

Materials and Methods

Two-year-old containerized seedlings (height 7–12 cm) of Fraser, momi, and Siberian fir were transplanted from Ray Leach “fir cells” (volume = 49 cm³) (Stuew & Sons, Corvallis, Ore.) to “super cells” (volume = 164 cm³) on 2 June 1998. The medium contained 1 peat:1 vermiculite (by volume). They were set outside under 50% shade lath. Overhead sprinklers provided 0.9 cm d⁻¹ of water, split between a morning and an afternoon application. On 12 June 1998, 30 plants of each species were inoculated with rice grains colonized by *P. cinnamomi*. A glass rod was used to make a hole (≈3 cm deep, 1 cm from the stem) in the medium in each tube. After inserting one grain, the hole was covered. Ten uninoculated plants were kept as controls. Plants were fertilized biweekly with Peter’s 20N–8.8P–16.6K soluble fertilizer (Scotts-Sierra Horticultural Products, Marysville, Ohio). Tubes were held in wooden trays, with one plant of each species per tray. Trays were arranged in a randomized complete block with 30 replications, and control trays were separated by enough space to prevent pathogen dispersal by splashing.

Plants were rated weekly for 8 weeks on a scale of 1 to 4: healthy (1), slightly chlorotic (2), severely necrotic (3), and dead (4). At the end of the experiment, roots were washed and subjectively rated by two people on a 1 to 5 scale: healthy (1), diseased 1% to 10% (2), 11% to 25% (3), 26% to 50% (4), and 51% to 100% (5). Ratings were averaged before analysis. Roots were washed and clipped into 1-cm sections. Five clumps (10–15 segments per clump) from each tree were placed on individual plates containing PAR medium (Kannwischer and Mitchell, 1978). Plates were stored on the laboratory bench for 2 d and then examined under a microscope. If *P. cinnamomi* appeared in any of the five clumps, the tree was recorded as infected.

The experiment was repeated beginning 17 July 1998 and ending 25 Sept. 1998. All data

<table>
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<tr>
<th>Species</th>
<th>Top rating</th>
<th>Root rating</th>
<th>Top weight</th>
<th>Isolation</th>
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<td>1.2</td>
<td>2.6 a</td>
<td>1.2 a</td>
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Train isolation to resistance to *Phytophthora cinnamomi* when grown in a shadehouse.
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were analyzed with GLM procedures (SAS Institute 1989), and means compared with Waller-Duncan K-ratio.

Results and Discussion

Fraser fir was very susceptible to *P. cinnamomi* (Table 1) in both experiments; nearly all seedlings died after 1 month. Symptoms developed more slowly in Siberian fir, but plants were severely diseased after 10 weeks in both experiments. Based on appearance of shoots, momi fir was relatively unaffected in either experiment even though a portion of the roots appeared diseased, and the pathogen was isolated from the roots of most plants (Table 1). In Expt. 1, virtually all root systems of Fraser and Siberian seedlings appeared diseased. In Expt. 2, the average root rating for Siberian fir was 3.6, indicating that up to 50% of the roots had visual symptoms. Average root rating for momi fir was 2.6 in Expt. 1, and 1.8 in Expt. 2 (Table 1). High values for roots of Fraser fir “controls” in both experiments possibly indicated a sensitivity to heavy watering, even in soilless medium, because *P. cinnamomi* was not isolated from roots of control seedlings in the second experiment. Likewise, momi fir roots appear to be sensitive to heavy watering in the absence of Phytophthora root rot, as only one control plant was infected with *P. cinnamomi*. Top weights for Fraser fir and Siberian fir seedlings were dramatically reduced following inoculation with *P. cinnamomi*.

Long-term survival of momi fir seedlings infected with *P. cinnamomi* is unknown. Fraser fir and Siberian fir succumbed very quickly to the disease in these short-duration experiments. Momii fir, however, survived and grew well even though the pathogen had infected a portion of the roots in 90% to 100% of the seedlings in both experiments. As a general observation, Fraser fir rarely survives in outdoor landscapes in the piedmont of North Carolina, probably because of the climate and Phytophthora root rot. In contrast, we have observed healthy specimens of momi fir growing in landscapes that would favor Phytophthora root rot. The date of budbreak and the needle morphology of momi fir make it a poor candidate for a Christmas tree in North Carolina, but these results suggest that it might be used as a rootstock for grafting *Abies* sp. with more favorable Christmas tree qualities, e.g., Fraser fir or Nordmann fir.

Literature Cited


