

PHYTOPHTHORA CINNAMOMI CAUSING ROOT ROT AND WILT
OF NURSERY-GROWN NATIVE WESTERN AZALEA AND SALAL

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ABSTRACT

A modified zoospore trapping assay was developed to isolate Phytophthora spp. from roots and soil. By using this assay or direct tissue plating, P. cinnamomi was isolated from western azalea, Rhododendron occidentale, and salal, Gaultheria shallon, common native plants of the Pacific Northwest. This is the first report of the disease on both hosts in commercial nurseries. The disease on R. occidentale was reproduced by artificial inoculation in the greenhouse; previously R. occidentale had been reported to be highly resistant.

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Root rot and wilt caused by Phytophthora cinnamomi Rands occurs throughout the world on many hosts (10, and Zentmyer, personal communication), sometimes in epiphytotic proportions. It is one of the most important soilborne diseases of woody ornamental plant species because of its broad host range, its widespread occurrence, and the lack of effective chemical controls. In the Northwestern United States we have observed Phytophthora root rot and wilt on rhododendrons, heathers, and bearberry, as well as several other important ornamental plant hosts. Usually P. cinnamomi is readily isolated from diseased tissue of such hosts. Some isolation attempts have failed, however, in plants expressing typical root rot and wilt symptoms. Although the use of media selective for phycomycetous fungi is helpful (7), still more selectivity and sensitivity are needed to increase the efficiency of recovery of P. cinnamomi and other Phytophthora spp. from infected tissues. This report describes a modified zoospore trap method which we routinely use, and reports the successful isolation of P. cinnamomi from two heretofore unreported hosts, western azalea, Rhododendron occidentale, and salal, Gaultheria shallon.

In the summer of 1974, we observed field-grown 1-yr-old liners of western azalea expressing dieback and wilt symptoms typical of Phytophthora wilt (8). Root rot was also severe and stem wood discoloration was evident. We isolated P. cinnamomi from these plants.

During that same 1974 season, but at two other nurseries, we also observed container-grown plants of salal expressing wilt symptoms. We isolated P. cinnamomi from roots of plants showing a range of foliar symptoms from veinal-reddening to yellow-green leaves, to parched, tan-colored and dry leaves. Typical root rot symptoms were also apparent. We were unable to recover P. cinnamomi from the roots of plants that appeared normal. In one nursery, the plant containers had been placed on black polyethylene sheets, which probably increased the disease by reducing drainage away from the containers as well as enhancing dissemination of the pathogen from container to container (Fig. 1).

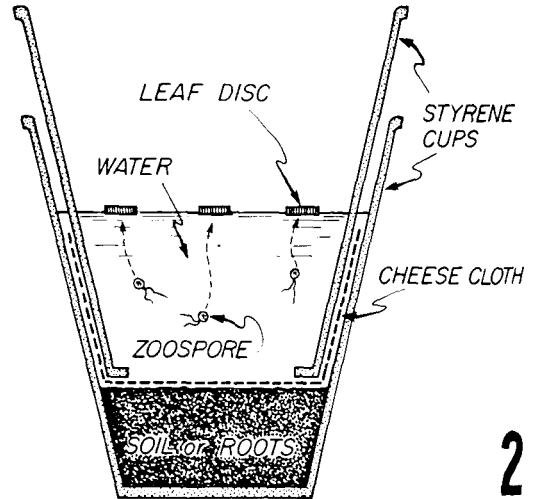
Isolation methods: We routinely isolate from plants showing Phytophthora-like root rot, stem discoloration, or wilt symptoms, or both, in two ways: a) direct plating, and b) zoospore trapping. The direct plating method involves the placement of surface-sterilized root or stem pieces on Schmitthenner's selective V8 juice medium (SV8M) (7). The zoospore trapping method we use is a modification of the soil assay systems of Marks and Kassaby (3) and Dance, et al. (1). Marks and Kassaby (3) floated 6-week-old eucalyptus cotyledons over samples of flooded soil as bait to trap zoospores released by germinated resting structures of P. cinnamomi. They observed the fungus directly on the bait or after plating the cotyledon on antibiotic medium. Dance, et al. (1), on the other hand, floated current season's needles of Pinus radiata and Cedrus deodora as bait over flooded soils infested with a variety of Phytophthora spp. They successfully recovered 12 Phytophthora species including P. cactorum (Leb. & Cohn) Schroet. which they stated rarely infects lupine radicles which often have been used as bait.



FIGURE 1. Phytophthora cinnamomi root rot and wilt on container-grown salal plants (Gaultheria shallon) growing in a nursery on black polyethylene, which probably enhanced the disease and dissemination of the pathogen.

FIGURE 2. Diagram of the zoospore trap assay used to recover Phytophthora cinnamomi from roots or soil.

ZOOSPORE-TRAP ASSAY



Our method, which is diagrammed in Figure 2, is a modification of the above methods, mainly in application rather than principle or design. We float three to ten 0.5-cm leaf discs of eucalyptus over soil or infected roots. We have used several different species of Eucalyptus (Eucalyptus gunnii, E. globulus, and E. cinerea), and all seem to work equally well. We have successfully trapped a number of known Phytophthora spp., but mainly P. cinnamomi. The floating discs are left on the water 24 hr, and then removed, blotted, and placed directly on SV8M. Recovery was not improved by allowing the discs to float for 48 or 72 hr. Likewise, surface sterilizing the discs in alcohol or chlorox did not affect recovery. Incubating the plates at 20° C instead of 25° C, however, does reduce interference from bacterial contaminants that often grow from the discs. When P. cinnamomi was trapped, it was visible under the dissecting microscope within 48 hr after plating. On the SV8M, P. cinnamomi colonies would only be 2-3 cm in diameter after 1 week. The biggest problem with this and other baiting systems, as Dance, et al. (1) pointed out, is the interference caused by species of Pythium which are so readily trapped from soil.

We have successfully applied the zoospore trap method to isolations from roots, whereas other methods have been applied primarily to recovery from soil (1, 3). When roots were being indexed for Phytophthora, the whole root system or representative portions were washed thoroughly, pushed to the bottom of the trap container, and flooded with distilled water. Eucalyptus discs were floated for 24 hr and plated as in the soil assays.

We have recovered P. cinnamomi from roots by using the zoospore trap method when direct plating of small root pieces has failed. The main advantages, however, are the great time savings and high sensitivity. We have indexed up to 100 samples in only a few hours compared with the many hours required for direct plating. In addition, it is easy to maintain a ready source of eucalyptus leaves by growing a plant or two in the greenhouse. This avoids the disadvantage of using seasonal fruits or other plant materials as bait (9). We feel that this method is quite sensitive and allows recovery of Phytophthora in a root system with relatively few infected

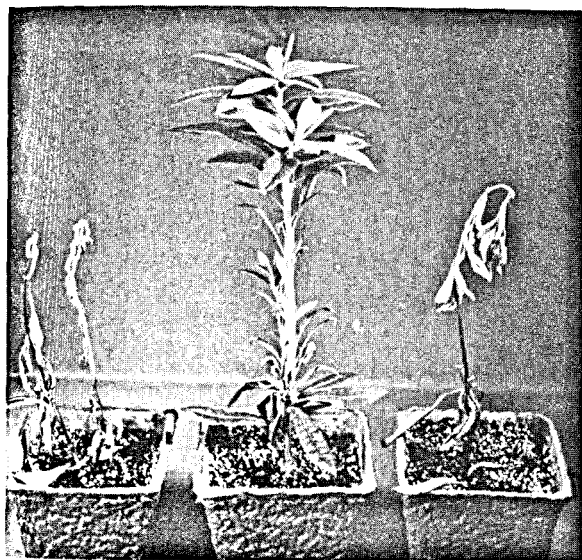


FIGURE 3. Root rot and wilt on two selections of Rhododendron occidentale rooted cuttings caused by Phytophthora cinnamomi in a greenhouse test. The center plant is the uninoculated control.

roots. We have observed similar sensitivity in recovery attempts from soil too, although Pythium is also readily recovered.

Greenhouse inoculation of western azalea: In 1974, Hoitink and Schmitthenner (2) reported on the relative resistance of Rhododendron species and hybrids to P. cinnamomi root rot and wilt. On the basis of artificial inoculation of rooted cuttings,

they reported R. occidentale (western azalea) to be highly resistant. Because we had observed typical root rot and wilt in the nursery on this host and had recovered P. cinnamomi, we attempted to inoculate R. occidentale in the greenhouse. We obtained rooted cuttings of two selections of R. occidentale (SM 232 and SM 602), and inoculated some of each with the isolate of P. cinnamomi from R. occidentale, or another isolate from a greenhouse forcing azalea. Plants were transplanted into a sand : soil : bark mix diluted 1 : 20 with washed vermiculite inoculum prepared according to the method of Mircetich and Matheron (5). Controls were grown in soil mix diluted with uninoculated vermiculite medium.

Plants inoculated with either isolate of P. cinnamomi expressed typical wilt symptoms in the greenhouse 3 weeks after transplant, and all eventually died. We recovered P. cinnamomi from these inoculated plants. Control plants remained healthy (Fig. 3). On the basis of this test and observations of the disease in the nursery, we could only conclude that R. occidentale is susceptible to P. cinnamomi. We cannot explain the discrepancy between these results and those of Hoitink and Schmitthenner (2). Perhaps the selections of R. occidentale they used were genetically more tolerant of P. cinnamomi than the two we tested, or had acquired some other biological protection that our test plants did not have. The form and quantity of inoculum they used was also different from ours.

The two plant species reported here as being susceptible to P. cinnamomi apparently have not been reported previously in detail. Middleton and Baxter (4), however, did report having recovered P. cinnamomi from some native plants in the Pacific Northwest, but not these species. Roth (6) mentioned that salal was a susceptible understory species in relation to P. cinnamomi on Douglas-fir in this area. He based this statement on a previous observation of a severe case of P. cinnamomi root rot and wilt of a landscape planting of salal on the Oregon State University campus in Corvallis, Oregon (personal communication). Our report of P. cinnamomi on salal and western azalea refers only to these species in commercial cultivation, and we have no data or observations on whether the disease occurs in the native habitat, or in landscape situations.

Literature Cited

1. DANCE, M. H., F. J. NEWHOOK, and J. S. COLE. 1975. Bioassay of Phytophthora spp. in soil. Plant Dis. Repr. 59: 523-527.
2. HOITINK, H. A. J., and A. F. SCHMITTHENNER. 1974. Resistance of Rhododendron species and hybrids to Phytophthora root rot. Plant Dis. Repr. 58: 650-653.
3. MARKS, G. C., and F. Y. KASSABY. 1974. Detection of Phytophthora cinnamomi in soils. Aust. For. 36: 198-203.
4. MIDDLETON, J. T., and D. V. BAXTER. 1955. The occurrence of Phytophthora and Pythium species on roots of native plants in northern California and southern Oregon. (Abstr.) Phytopathology 45: 694.

5. MIRCETICH, S. M., and M. E. MATHERON. 1976. Phytophthora root and crown rot of cherry trees. *Phytopathology* 66: 549-558.
6. ROTH, L. F. 1963. Phytophthora cinnamomi root rot of Douglas-fir. *Phytopathology* 53: 1128-1131.
7. SCHMITTHENNER, A. F. 1973. Isolation and identification methods for Phytophthora and Pythium. Proc. First Woody Ornamental Disease Workshop, U. Missouri - Columbia. pp. 94-110.
8. WHITE, R. P. 1937. Rhododendron wilt and root rot. New Jersey Agric. Exp. Stn. Bull. 615. 32 pp.
9. ZENTMYER, G. A., J. D. GILPATRICK, and W. A. THORN. 1960. Methods of isolating Phytophthora cinnamomi from soil and from host tissue. *Phytopathology* 50: 87.
10. ZENTMYER, G. A., and W. A. THORN. 1967. Hosts of Phytophthora cinnamomi. Calif. Avocado Soc. Yearb. 51: 177-186.

SUSCEPTIBILITY OF CERTAIN SAINTPAULIA
SPECIES AND CULTIVARS TO BACTERIAL BLIGHT

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ABSTRACT

Thirty-seven cultivars, species, and species derivatives of Saintpaulia were tested for resistance to Erwinia chrysanthemi. All cultivars were moderately to highly susceptible except S. ionantha 'Apollo Pink' and S. ionantha 'Athena'.

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Erwinia chrysanthemi Burkholder, et al. causes a wilt or blight of a large and diverse range of plants. One of the demonstrated hosts is the African violet (Saintpaulia ionantha) (1, 3, 4, 5).

Knauss and Miller (2) studied this blight on the 'Diana' type of African violet. They described the symptoms as a brown to black root and crown rot that progressed through the petioles, and a greasy brown to black leaf infection. They successfully performed Koch's postulates with E. chrysanthemi by using excised leaves of Diana type African violets.

This study was undertaken to evaluate the relative resistance of several species and cultivars of Saintpaulia to E. chrysanthemi.

MATERIALS AND METHODS

Thirty-seven cultivars, species, and species derivatives of Saintpaulia were used in this study. Twenty-three named cultivars of Saintpaulia were supplied by Tinari Greenhouses, Huntingdon Valley, Pennsylvania. All species and species derivatives were supplied by Henry Peterson, Cincinnati, Ohio. All species and cultivars were propagated by leaf cuttings 5 months before inoculation and rooted in a steam sterilized 1 : 2 : 2 peat, perlite, and vermiculite medium. Hormodin 1 was used to promote rooting. Peter's 15-30-15 fertilizer was used every second or third watering after plantlets were visible. The plants were separated and transferred to a steam sterilized 2 : 1 : 1 peat, perlite, and vermiculite medium in cell packs before inoculation. Plants were grown at 20-23° C in a shaded greenhouse.