Screening Woody Ornamental Cuttings for Propagation Diseases

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ABSTRACT

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The effect of isolates of *Rhizoctonia, Phytophthora,* and *Pythium* species on propagation of cuttings from 16 woody plant species was evaluated under intermittent mist in sand or peat-perlite during June, July, and August 1979. Symptoms ranged from severe basal stem rot and death to minor necrosis and root stunting. Rooting medium had little influence on symptom expression in most cases.

Additional key words: *Cornus stolonifera, Cotinus coggygria, Cotoneaster apiculata, Deutzia gracilis, Euonymus alata, Forsythia × intermedia, Hedera helix, Ligustrum amurense, Lonicera tatarica, Magnolia stellata, Myrica pensylvanica, Rhamnus frangula, Rhodotypos scandens, Rhus aromatica, Ribes alpinum, Viburnum trilobum*

The propagation of woody ornamental cuttings under intermittent mist is a widely used technique in the nursery trade (6). During this initial production phase, cuttings are particularly susceptible to attack by *Rhizoctonia, Phytophthora,* and *Pythium* species (4,7,11). The resulting diseases may kill cuttings and cause severe losses during propagation (11) or in later stages of plant growth (13). The variability of symptom expression makes diagnosis of the causal pathogen difficult; in some cases, incorrectly identified diseases result in infected plants passing into later stages of nursery production (1,11).

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Few studies have identified or described specific woody plant-pathogen interactions in the mist propagation bed. We evaluated 16 woody species for disease symptoms, degree of rooting, and survival of cuttings in media (sand or peat-perlite) infested with combined isolates from each of *Pythium, Phytophthora,* or *Rhizoctonia.*

MATERIALS AND METHODS

Isolates and inoculum. Six isolates of *Pythium,* seven of *Phytophthora,* and five of *Rhizoctonia* species, obtained from soil and woody and nonwoody hosts, were used (Table 1). Hyphal tip isolates of *Pythium* and *Phytophthora* were maintained on a modified V-8 juice agar (8). Hyphal tip isolates of *Rhizoctonia* were grown on glucose-yeast extract agar (5).

To prepare the inoculum for each woody host, two petri plates of each isolate were incubated for 1 wk at 24 C. The combined isolates from each fungal genus were ground for 6–8 sec in a Waring Blendor in 1,000 ml of sterile,

distilled water. Each suspension contained about 3,000–5,000 propagules per milliliter (serial dilution count).

Propagation and inoculation techniques. Softwood terminal stem cuttings of red-osier dogwood (*Cornus stolonifera*), smoketree (*Cotinus coggygria* 'Velvet Cloak'), cranberry cotoneaster (*Cotoneaster apiculata*), slender deutzia (*Deutzia gracilis*), dwarf winged euonymus (*Euonymus alata* 'Compacta'), forsythia (*Forsythia* × *intermedia* 'Spring Glory'), English ivy (*Hedera helix* 'Baltica'), Amur privet (*Ligustrum amurense*), honeysuckle (*Lonicera tatarica* 'Zabelii'), star magnolia (*Magnolia stellata*), bayberry (*Myrica pensylvanica*), tall hedge buckthorn (*Rhamnus frangula* 'Columnaris'), jetbead (*Rhodotypos scandens*), fragrant sumac (*Rhus aromatica*), alpine currant (*Ribes alpinum*), and dwarf cranberry bush (*Viburnum trilobum* 'Compactum') were collected between 12 June and 16 July 1979 from established plants on the University of Illinois campus at Urbana. The cuttings were stored at 4 C for up to 15 hr, then stripped of lower foliage and recut to 13-cm length. The cut stems were dipped for 5 sec in 1 g/L of indolebutyric acid in 50% aqueous alcohol immediately before they were inserted in the medium.

Four wooden flats (55 × 35 × 8 cm) were filled with sand and four were filled with peat-perlite (1:1) for each woody species. Ten furrows 6 cm deep extending the width of the flat (35 cm) were made in the moistened medium, and a 50-ml sample of inoculum was poured into each furrow. Ten cuttings were inserted into each furrow. Ninety-six woody host-pathogen-medium combinations (16 hosts, three pathogen mixtures, and two rooting media) were tested in a completely randomized design. Two flats (one for each medium) treated with a sterile agar suspension were included for each plant species.

The cuttings were maintained in a greenhouse covered with 4-mil polyethylene over 50% Saran shading throughout the summer. Between 0600 and 1900 hours, the cuttings were misted for 8 sec every 4 min. Daytime temperature in the greenhouse averaged 27 C.

At biweekly intervals for 10 wk after inoculation, samples of 10 cuttings were randomly removed from each treatment and washed. Basal rot, foliar necrosis, and defoliation were rated on each cutting on a scale of 0 (healthy) to 4 (severely necrotic or defoliated). Isolations of the inoculated pathogens from infected tissues were made. Isolates from moderately or severely affected plants are being identified to species and will be used to reinoculate healthy cuttings to establish pathogenicity.

Table 1. *Pythium* (Py), *Phytophthora* (Ph), and *Rhizoctonia* (R) isolates used in this study

Isolate number	Fungus	Source	Location
Py_1	*Pythium ultimum* Trow	*Lycopersicon esculentum*	Ohio
Py_2	*P. ultimum*	*Beta vulgaris* 'Ruby Queen'	New York
Py_3	*P. ultimum*	*Phaseolus vulgaris*	New York
Py_4	*P. splendens* Braun	*Rhododendron* sp.	Ohio
Py_5	*P. aphanidermatum* (Edson) Fitzp.	*Capsicum* sp.	Ohio
Py_6	*P. irregulare* Buism.	*Pelargonium peltatum*	Ohio
Ph_1	*Phytophthora parasitica* Dast	*Gypsophila* sp.	Florida
Ph_2	*P. parasitica*	*Kalanchoe* sp.	Florida
Ph_3	*P. cactorum* (Leb. & Cohn) Schroet.	*Malus* sp.	Ohio
Ph_4	*P. citrophthora* (Smith & Smith) Leonian	*Rhododendron* sp.	Ohio
Ph_5	*P. cinnamomi* Rands	*Rhododendron* sp.	Ohio
Ph_6	*P. cinnamomi*	*Rhododendron* sp.	Rhode Island
Ph_7	*P. cryptogea* Pethybr. & Laff.	*Solanum* sp.	Ohio
R_1	*Rhizoctonia solani* Kuehn	Soil	Illinois
R_2	*R. solani*	Soil	Georgia
R_3	*R. solani*	*Impatiens* sp.	Illinois
R_4	*R. solani*	*Pelargonium* × *hortorum*	Illinois
R_5	*Rhizoctonia* sp.	*Aegopodium podagraria*	Illinois

RESULTS

Basal stem necrosis and defoliation were the most common symptoms observed. Severe cutting mortality occurred in eight of the 16 species. Overall basal rot ratings for the 16 species

Table 2. Pathogenicity of *Rhizoctonia* (R), *Phytophthora* (Ph), and *Pythium* (Py) on 16 species of woody ornamental cuttings[a]

	Mean disease rating[b]										
	Basal stem rot				Defoliation				Reisolation (%)		
Genus	R	Ph	Py	C[c]	R	Ph	Py	C[c]	R	Ph	Py
Cornus	3.0	0.3	0.1	0.0	2.6	0.6	0.2	0.1	53	0	0
Cotinus	3.8	3.3	2.8	0.9	2.4	2.6	2.4	0.9	41	39	33
Cotoneaster	1.7	3.2	0.8	0.0	1.3	1.6	0.0	0.0	54	61	61
Deutzia	3.3	2.5	2.7	0.0	2.1	0.4	0.6	0.0	29	24	78
Euonymus	1.5	0.8	1.3	0.0	0.9	0.0	1.1	0.3	44	17	44
Forsythia	0.7	2.0	1.6	0.0	0.0	0.0	0.1	0.0	14	44	67
Hedera	1.3	0.6	1.1	0.0	0.9	0.0	0.8	0.0	28	22	22
Ligustrum	0.8	0.1	1.2	0.0	0.0	0.0	0.0	0.0	6	44	22
Lonicera	1.6	1.1	1.6	0.0	0.8	0.4	0.2	0.0	11	28	44
Magnolia	2.6	2.7	1.6	0.0	2.0	1.0	0.8	0.1	22	11	44
Myrica	1.2	1.6	1.1	0.0	0.3	0.9	0.3	0.0	17	44	22
Rhamnus	3.9	3.9	3.8	2.1	3.4	3.8	3.7	2.8	33	17	14
Rhodotypos	1.3	3.3	3.5	0.2	0.4	3.1	3.5	0.2	21	21	25
Rhus	3.8	3.7	3.6	0.2	3.2	3.5	2.6	0.1	22	17	33
Ribes	1.6	2.4	1.2	0.0	1.0	2.2	0.9	0.0	75	58	50
Viburnum	2.1	0.2	1.9	0.0	0.9	0.1	0.2	0.0	58	11	50
LSD ($P = 0.05$)	1.01	0.92	0.98	...	1.26	1.05	1.12	...	...	...	...

[a] Average disease rating of 40 cuttings propagated in peat-perlite (10 cuttings evaluated biweekly 4–10 wk after initial propagation date). Mean separation in columns by least significant difference (LSD) ($P = 0.05$).

[b] Disease rating scale: 0 = no evidence of basal stem necrosis or defoliation; 1 = less than 0.5 cm basal stem rot or less than 10% defoliation; 2 = 0.5–1.5 cm basal stem rot or 10–25% defoliation; 3 = 1.6–3.0 cm basal stem rot or 26–50% defoliation; 4 = more than 3.0 cm basal stem rot or more than 51% defoliation.

[c] C = control (sterile agar only).

were significantly correlated with defoliation ratings: $r = 0.96$ (*Rhizoctonia*), 0.85 (*Phytophthora*), and 0.85 (*Pythium*).

The pathogenicity of combined isolates from each fungal genus varied among the woody hosts (Table 2). The overall severity of symptoms produced by the different groups of fungi was not significantly different, although variations were observed within host species.

Symptoms of *Rhizoctonia* infection usually appeared within 10 days of inoculation. Brown basal stem necrosis appeared first at the cut stem surface and extended acropetally. Foliar necrosis (beginning on lower leaves) appeared concurrently with basal rot, but defoliation usually did not occur until 25–75% of the laminar surface became necrotic. Leaf-to-leaf spread of *Rhizoctonia* was observed on the *Cornus, Cotinus, Deutzia, Magnolia,* and *Rhus* cuttings. Fungal mycelium and sclerotia were often observed on the upper surfaces of dead leaves.

Symptoms caused by *Phytophthora* and *Pythium* were indistinguishable from each other and typically appeared later than those of *Rhizoctonia* (15–20 days after inoculation). Blackened basal stem lesions started at cut stem surfaces and stem wounds where foliage had been excised. On severely infected hosts, the stem necrosis discolored the entire cutting in 5–6 wk, and the tissue became soft and water-soaked. Wilting usually preceded any aboveground necrosis. Unlike *Rhizoctonia* infection, defoliation often occurred without prior foliar necrosis. Root production above a limited basal stem lesion, root tip decay, suppressed foliar and root growth, and premature fall color were common symptoms of cuttings moderately affected by *Pythium* and *Phytophthora* infections.

Rooting medium had little influence on symptom expression in most cases, although in *Rhizoctonia*-inoculated *Cornus* and *Hedera*, *Phytophthora*-inoculated *Deutzia* and *Forsythia*, and *Pythium*-inoculated *Lonicera*, the pathogen was significantly less destructive in the sand medium.

At least nine cuttings randomly selected from each woody species-pathogen-medium treatment combination were sectioned in an attempt to reisolate the pathogen. A 25–50% recovery of pathogens from infected plant tissue was common (Table 2).

Severe basal stem rotting in all treatments of *Cotinus, Magnolia, Rhamnus, Rhodotypos,* and *Rhus* precluded successful root development, and most infected samples did not survive the propagation period. In treatments of *Forsythia, Ligustrum,* and *Myrica*, pathogenesis had virtually no effect, and roots developed successfully. Host reactions to inoculation are summarized in Table 3.

Table 3. Host reaction to inoculation

Fungus	Susceptibility	Hosts
Rhizoctonia	High	*Cornus, Cotinus, Deutzia, Magnolia, Myrica, Rhamnus, Rhus*
	Moderate	*Cotoneaster, Euonymus, Hedera, Lonicera, Rhodotypos, Ribes, Viburnum*
	Low or none	*Forsythia, Ligustrum*
Phytophthora	High	*Cotinus, Cotoneaster, Deutzia, Magnolia, Myrica, Rhamnus, Rhodotypos, Rhus, Ribes*
	Moderate	*Forsythia, Hedera*
	Low or none	*Cornus, Euonymus, Ligustrum, Lonicera, Viburnum*
Pythium	High	*Cotinus, Deutzia, Rhamnus, Rhodotypos, Rhus*
	Moderate	*Euonymus, Forsythia, Magnolia, Ribes, Viburnum*
	Low or none	*Cornus, Cotoneaster, Hedera, Ligustrum, Lonicera, Myrica*

DISCUSSION

Cuttings are highly stressed plant tissues and are more subject to invasion by microorganisms than are rooted plants. Although the rooting medium may become contaminated with pathogens early in propagation, contamination is more likely to occur in later stages, and as a result, disease symptoms can be altered (3). All disease symptoms we recorded resulted from infestation of the medium at the time the cuttings were inserted.

The differential susceptibility of cuttings of woody hosts to inoculation with *Rhizoctonia, Pythium,* and *Phytophthora* was established. The severe propagation disease symptoms observed correspond to general descriptions outlined previously (11). Defoliation, an aboveground symptom, was a good diagnostic indicator of developing basal stem rot symptoms. Foliar necrosis was a reliable indicator only for *Rhizoctonia*-infected cuttings during initial weeks of propagation.

The effect of rooting medium on symptom expression noted on a few of the woody hosts may in part be attributable to the influence of the medium on the pathogen's environment (12). MacDonald and Duniway (10) reported reduced zoospore mortality in finer textured soil, and Blair (2) determined that *Rhizoctonia* growth was greatest in media with low soil moisture content. The several cases we observed of more severe disease in peat-perlite than in sand do not correspond to the findings of earlier reports. The rooting medium may also affect the character of the roots produced by a cutting (9) and consequently its ability to suppress symptoms.

Cuttings with minor or moderate infections often produced adequate roots and survived the propagation period and overwintering stress; eg, nearly all infected cuttings of *Ligustrum, Myrica,* and *Forsythia* survived after the first winter. This confirms earlier reports (13) that diseased plants may be passed into later stages of production by propagators and nurserymen.

LITERATURE CITED

1. Baker, K. F. 1971. Disease-free propagation in relation to standardization of nursery stock. Comb. Proc. Int. Plant Propagators Soc. 21:191-200.
2. Blair, I. D. 1943. Behaviour of the fungus *Rhizoctonia solani* Kuhn in the soil. Ann. Appl. Biol. 30:118-127.
3. Camp, W. H. 1956. Micro-organisms in soil and their action on plants. Comb. Proc. Int. Plant Propagators Soc. 6:107-121.
4. Goss, O. M. 1978. Pathogens in plant propagation. Comb. Proc. Int. Plant Propagators Soc. 28:400-406.
5. Gottlieb, D., and Van Etten, J. L. 1966. Changes in fungi with age. 1. Chemical composition of *Rhizoctonia solani* and *Sclerotium bataticola*. J. Bacteriol. 91:161-168.
6. Hartmann, H. T., and Kester, D. E. 1975. Plant Propagation, Principles and Practices. Prentice-Hall, Inc., Englewood Cliffs, NJ. 662 pp.
7. Hoitink, H. A. J. 1968. Disease control during propagation. Comb. Proc. Int. Plant Propagators Soc. 18:238-241.
8. Hoitink, H. A. J., and Schmitthenner, A. F. 1969. Rhododendron wilt caused by *Phytophthora citricola*. Phytopathology 59:708-709.
9. Long, J. C. 1932. The influence of rooting media on the character of the roots produced by cuttings. Proc. Am. Soc. Hortic. Sci. 29:352-355.
10. MacDonald, J. D., and Duniway, J. M. 1978. Influence of soil texture and temperature on the motility of *Phytophthora cryptogea* and *P. megasperma* zoospores. Phytopathology 68:1627-1630.
11. McCully, A. J., and Thomas, M. B. 1977. Soil-borne diseases and their role in plant propagation. Comb. Proc. Int. Plant Propagators Soc. 27:339-350.
12. Powell, C. C., Jr. 1977. Control of disease problems as it relates to plant propagation. Comb. Proc. Int. Plant Propagators Soc. 27:477-479.
13. Reisch, K. W. 1963. Diseases initiated in the propagating phase which later cause plant loss. Comb. Proc. Int. Plant Propagators Soc. 13:158-162.