Hot Water Treatments Are Effective and Disinfestants Are Ineffective in the Control of *Rhizoctonia* Infesting Stem Cuttings of 'Gumpo White' Azalea©

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Azalea web blight is an annual problem on some evergreen azalea cultivars grown in containerized nursery production in the southern and eastern United States. The disease is caused by binucleate *Rhizoctonia* species. From 5% to 20% of new shoot growth in the upper canopy of the plant can be colonized by Rhizoctonia during the spring when new growth is harvested for propagation. In our study, pathogen elimination was assessed using leafless stem pieces of *Rhododendron* 'Gumpo White' ('Gumpo White' azalea) that had been inoculated and colonized with an isolate of binucleate *Rhizoctonia* AG P. Potential tissue damage from hot water was assessed using leafy, terminal stem cuttings of 'Gumpo White' azalea. Disinfestants (sodium hypochlorite, hydrogen dioxide, and quaternary ammonium chloride) and fungicides (chlorothalonil plus thiophanate methyl, and flutolanil) did not eliminate *Rhizoctonia* from stem cuttings. However, *Rhizoctonia* was eliminated by submersing stems in 122 °F (50 °C) water for 21 min and in 131 °F (55 °C) water for 6 min. Minor leaf damage resulted from submersion of cuttings in 122 °F water for up to 40 min.

OBJECTIVE

Azalea web blight is a problem on some azalea cultivars during nursery propagation and production. We have discovered that spring shoot growth used for stem cutting propagation can harbor the pathogen, thus the pathogen is unsuspectingly propagated with the plant. The objective of this study was to evaluate and select disease control methods, including commercially available disinfestants and hot water treatments, which could potentially eliminate the pathogen from cuttings without damaging plant tissue.

MATERIALS AND METHODS

Pathogen control was assessed with 1.2-in. (3-cm) leafless stem pieces that had been inoculated and colonized with an isolate of binucleate *Rhizoctonia* AG P. When testing disinfestants, colonized stem pieces were fully submersed in the solution for 10 min. When testing fungicides, stem pieces were submersed in the solution for several seconds, and then allowed to air dry for 2 h. When testing the use of hot water, stem pieces were submersed for the specified time period (30 sec to 45 min). Treated stem pieces were placed on water agar to determine the percentage of recovery or absence of the pathogen.

Potential tissue damage from hot water was assessed using terminal cuttings of *Rhododendron* 'Gumpo White' that had green leaves. After submersion in hot water for the specified time period, cuttings were placed in a humid chamber for 24 h to allow visible expression of leaf tissue damage. Overall damage was calculated from the number of leaves expressing no, moderate, or severe leaf damage.

RESULTS AND DISCUSSION

Disinfestants (sodium hypochlorite, hydrogen dioxide, and quaternary ammonium chloride) and fungicides (chlorothalonil plus thiophanate methyl, and flutolanil) at their respective rates did not eliminate *Rhizoctonia* from stem cuttings. These results were surprising, but demonstrate the importance of experimental evaluations.

Rhizoctonia was eliminated by submersing stems in 122 °F (50 °C) water for 21 min and in 131 °F (55 °C) water for 6 min, but was not reduced by submersing stems in 113 °F (45 °C) water for up to 45 min. Minor leaf damage resulted from submersion of cuttings in 131 °F water for 6 min and in 122 °F water for up to 40 min. The level of tissue damage was judged to be low enough that rooting would not be negatively affected; this is currently being verified with further experiments. The margin of error in treatment duration between killing the pathogen and severely damaging plant tissue is narrower at 131 °F than at 122 °F. Severe leaf damage occurred when cuttings were submerged in 131 °F water for 14 min or in 135 °F for 30 sec.

Although hot water submersion is the only treatment to date that has effectively eliminated *Rhizoctonia* from azalea stem pieces, further studies with fungicides are planned. Based on results from bench-top studies, the application of fungicides to plants prior to collecting stem cuttings has shown some potential for preventing *Rhizoctonia* from growing upward onto the current season's shoot growth. Several fungicide timing patterns will be evaluated in field trials for this purpose. Additional laboratory studies are planned to determine if surfactants and/or application methods can improve chemical efficacy.

Table 1. Experiment number, treatment description, and type of tissue treated, and experimental results from a series of experiments examining efficacy of chemicals (disinfestants and fungicides) and hot water submersion (temperature and duration) for eliminating *Rhizoctonia* AG P from stem cuttings of 'Gumpo White' azalea. Stem pieces colonized with *Rhizoctonia* AG P were used to assess recovery of the fungus in response to chemical and hot water treatments, while terminal stem cuttings were used to assess leaf damage in response to hot water treatment.

Expt.	Chemical and hot water treatments	Tissue	Results
1	Sodium hypochlorite (household bleach) at 0, 3050, 6100**, 9150, or 12,200 ppm a.i. for 10 min; Hydrogen dioxide (Zerotol; Biosafe Systems, Glastonbury, Connecticut) at 0, 1350, 2700*, 13,500, or 27,000 ppm a.i. for 10 min; Quaternary ammonium chlorides (Green Shield; Whitmire Micro-Gen Research Laboratories, Inc., St. Louis, Missouri) at 0, 500, 1000*, 5000, or 10,000 ppm a.i. for 10 min.	Stem pieces colonized by *Rhizoctonia* for 7 days	Disinfestants were all ineffective against *Rhizoctonia*.
2	Chlorothalonil + thiophanate-methyl (Spectro 90; Cleary Chemical, Dayton, New Jersey) at 0, 431 + 108, 863 + 216*, or 1726 + 431 ppm a.i. for 3 to 4 sec; Flutolanil (Contrast; Scotts-Sierra Crop Protection Co., Marysville, Ohio) at 0, 157.5*, 315, or 630 ppm a.i. for 3 to 4 sec.	Stem pieces colonized by *Rhizoctonia* for 7 days	Fungicides were all ineffective against *Rhizoctonia*.
3	Deionized water for 10 min (control); Sodium hypochlorite at 12,200 ppm a.i. for 10 min; Flutolanil at 315 ppm a.i. for 3 to 4 sec.	Stem pieces colonized by *Rhizoctonia* for 3, 5, and 7 days	Disinfestants and fungicides were all ineffective against *Rhizoctonia*.

Table 1. Continued.

4	Sodium hypochlorite at 0 or 12,200 ppm a.i. for 10 min; Sodium hypochlorite at 12,200 ppm a.i. + Surf-Ac 820 (Drexel Chemical Co., Memphis, Tennessee) 820 at 1920* ppm a.i. for 10 min; Hot water at 113 or 131°F for 5, 25, or 45 min.	1. Stem pieces colonized by *Rhizoctonia* for 7 days 2. Terminal stem cuttings (hot water only)	Sodium hypochlorite was ineffective against *Rhizoctonia*. Hot water at 113 °F was ineffective against *Rhizoctonia* at all durations. Hot water at 131 °F was completely effective in eliminating *Rhizoctonia* at all treatment durations. Minor leaf damage on cuttings occurred using hot water at 113 °F, while moderate to severe damage occurred at 131 °F. Leaf damage increased with increasing duration of exposure using hot water at 131 °F.
5	Hot water at 122 °F for 0, 1.5, 3, 4.5, 6, 7.5, 9, 10.5, 12, 15, 18, or 21 min; Hot water at 131 °F for 0, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5.5, 6.5, or 7.5 min; Hot water at 122 and 131 °F for 0, 1, 3, 5, 7, 9, 15, 20, 25, 30, 35, or 40 min.	Stem pieces colonized by *Rhizoctonia* for 7 days Terminal stem cuttings	*Rhizoctonia* was eliminated from azalea stem pieces with increasing duration of exposure to hot water at 122 °F and 131 °F. Minor leaf damage occurred with submersion of cuttings in 122 °F water, and that damage did not significantly increase over 40 min. Leaf damage increased with increasing duration of exposure to hot water at 131 °F.
6	Hot water at 126, 131, 136, 142, 147, 153, or 158 °F for 0, 30, and 60 sec.	(1) Stem pieces colonized by *Rhizoctonia* for 7 days; (2) Terminal stem cuttings	*Rhizoctonia* was eliminated from stem pieces with increasing water temperature when stem pieces were submerged for 30 sec and 60 sec. Leaf damage on cuttings increased with increasing water temperature when stem pieces were submersed for 30 sec and 60 sec.

**Commonly used rate.

*Registered label rate.