

## Chemical and Hot Water Treatments to Eliminate *Rhizoctonia* from Azalea Stem Cuttings: Failures and Successes<sup>©</sup>

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### INTRODUCTION

Most disease control practices work by preventing a pathogen from spreading from one area to another, by preventing build-up of the pathogen's inoculum at a site, and by preventing the inoculum from infecting the host plant. In a propagation setting, exclusion of a pathogen from the propagation house can be a powerful tool. Once a pathogen has entered a propagation house, most controls attempt to limit infection, which also serves to limit inoculum build-up. Between crops, killing all pathogen propagules that remain on greenhouse surfaces allows a fresh start for the next crop. While these general control principles are commonly used, the specific practices and combination of practices needed to achieve these goals will vary depending on the pathogen being controlled. Proper diagnosis of problems is key to control, as problems may or may not be caused by a pathogen. Controls should be selected primarily based on the disease problems that have a history of occurrence at a specific greenhouse or nursery facility.

*Rhizoctonia* fungi cause a range of disease problems during propagation and production of herbaceous and woody ornamental plants. The senior author has discovered that binucleate *Rhizoctonia* species live on live azalea stems and in the growing media of container-grown plants all year. In May and June, a small percentage of healthy appearing *Rhododendron* 'Gumpo White' stems collected for cutting propagation can harbor the pathogen. While most of this research was done with 'Gumpo White', it is likely that many azalea cultivars are similarly colonized by *Rhizoctonia*. The warm, moist conditions provided for cuttings also will favor growth of *Rhizoctonia* across plug trays. A series of experiments was conducted to identify controls that eliminate *Rhizoctonia* from azalea stems and to measure the potential for damage from hot water treatments to stem cuttings of 12 azalea cultivars. This is the first step toward a larger objective of preventing the spread of binucleate *Rhizoctonia* back onto clean plants during the entire propagation and production cycle.

### DISINFESTANTS AND FUNGICIDES

To evaluate control of *Rhizoctonia*, azalea stems were stripped of leaves and then exposed to mycelial colonization by the fungus. Infested stems were submerged in disinfestant solutions [bleach (sodium hypochlorite), Green Shield (quaternary ammonium chloride), ZeroTol (hydrogen dioxide)] at a range of rates (below, at, and above registered label rates) for 10 min and in fungicide solutions [Spectrum

(chlorothalonil plus thiophanate methyl), Contrast 70WP (flutolanil)] at label rates for 4 sec. After chemical treatment, stems were set on agar media to recover the pathogen. (Mention of a trademark, proprietary product, or vendor does not constitute a guarantee or warranty of the product by the Department of Agriculture or Mississippi State University and does not imply its approval to the exclusion of other products or vendors that also may be suitable.)

Disinfectants and fungicides did not eliminate *Rhizoctonia* from stem cuttings (Copes and Blythe, 2009). The results were disappointing, but demonstrate the importance of experimental evaluations. Several reasons could explain why disinfectants did not work in this situation, such as mycelium being protected from chemical exposure by penetrating bark tissue; however, this was not documented in the study. Like every existing disease control method, disinfectants provide good pathogen control in some situations and moderate to poor to no control in other situations (Copes, 2004; Copes, 2009). Advancements in all control methods, including sanitization, will be important for producing high quality plants, while conforming to the stricter environmental regulations and economic pressures that likely will occur in the future.

### **HOT WATER TREATMENT TO ELIMINATE RHIZOCTONIA**

Stem pieces infested with *Rhizoctonia* were submersed in hot water 45–81 °C (113–178 °F) for 30 sec to 45 min. After treatment, stem pieces were set on agar media to recover the pathogen. *Rhizoctonia* was eliminated (not recovered) from stems submersed in 122 °F (50 °C) water for 21 min and in 55 °C (131 °F) water for 6 min, but was not reduced by submersing stem pieces in 45 °C (113 °F) water for up to 45 min (Copes and Blythe, 2009).

### **POTENTIAL FOR LEAF DAMAGE FROM HOT WATER TREATMENT**

As an initial measure of the potential for hot water treatments to damage cuttings, terminal leafy cuttings of ‘Gumpo White’ azalea were exposed simultaneously to the same hot water treatments tested to eliminate *Rhizoctonia*. After treatment, cuttings were placed in high relative humidity conditions inside closed plastic containers and leaf damage was assessed after 24 h. Minor leaf damage resulted on cuttings submersed in 55 °C (131 °F) water for 6 min and in 50 °C (122 °F) water for up to 40 min (Copes and Blythe, 2009). However, the margin of error in time between killing the pathogen and severely damaging leaf tissue is narrower at 55 °C (131 °F) than at 50 °C (122 °F). Severe leaf damage occurred when cuttings were submerged in 55 °C (131 °F) water for longer than 13 min.

### **CULTIVAR ROOTING RESPONSE FOLLOWING HOT WATER TREATMENT**

To confirm if hot water treatments would detrimentally effect leaf tissue and/or rooting, stem cuttings were collected from 12 *Rhododendron* (azalea) taxa [‘Conleb’ (Autumn Embers™); ‘Fashion’; *formosum*; ‘Gumpo White’; ‘Hardy Gardenia’; ‘Hershey’s Red’; ‘Macranthum Roseum’; ‘Midnight Flare’; ‘Red Ruffles’; ‘Renee Michele’; ‘Roblel’ (Autumn Debutante™) azalea; and ‘Watchet’] during May and June 2009; submerged in 50 °C (122 °F) water either for 0 or 20 min (Experiment 1) or for 20, 40, 60, or 80 min (Experiment 2); inserted in a peat and pine bark medium in 72-cell trays; and maintained under mist for approximately 7 weeks. Leaf damage was assessed within 2 to 7 days after hot water treatment. Root growth and number of healthy leaves were assessed at the end of the experiment.

**Table 1.** Degree of rooting after leafy, terminal cuttings of twelve azalea cultivars were submerged in 50 °C (122 °F) water for 20 to 80 min, inserted in a pine bark/peat medium in plug trays, and maintained for 7 weeks under a 9 sec mist at 20-min intervals from 7:00–19:00 daily.

<i>Rhododendron</i> taxa	Duration of submersion			
	20 min	40 min	60 min	80 min
'Conleb' (Autumn Embers™)	Good	Good	Good	Moderate
'Fashion'	Good	Good	Moderate	Poor
<i>formosa</i>	Good	Moderate	Poor	Poor
'Gumpo White'	Good	Good	Good	Good
'Hardy Gardenia'	Good	Good	Moderate	Moderate
'Hershey's Red'	Good	Good	Moderate	Moderate
'Macranthum Roseum'	Good	Moderate	Poor	Poor
'Midnight Flare'	Good	Good	Poor	Poor
'Red Ruffles'	Good	Moderate	Moderate	Poor
'Renee Michele'	Good	Good	Moderate	Moderate
'Roblel', Autumn Debutante™ azalea	Good	Good	Good	Moderate
'Watchet'	Good	Good	Moderate	Poor

Good = complete root development around the media plug and no symptoms of leaf damage.

Moderate = root development did not completely surround the media plug, some leaf damage, and possibly a few dead stems.

Poor = root development limited to a small portion of the media plug, severe leaf damage, and many dead stems.

In Experiment 1, rooting was equal between stem cuttings not submersed and submersed in 50 °C (122 °F) water for 20 min for nine of the twelve cultivars. 'Fashion' had slightly less root growth on hot-water-treated cuttings, but root systems likely would have been comparable within a few weeks. 'Conleb' (Autumn Embers™) and 'Midnight Flare' had slightly more root growth for hot-water-treated cuttings. By submersing stem cuttings in 50 °C (122 °F) water for 20 to 80 min (Experiment 2), it was evident that cultivars vary in sensitivity to hot-water treatment (Table 1). As in earlier studies with 'Gumpo White', submerging cuttings in 50 °C (122 °F) water for 40 min did not severely damage any of the twelve cultivars tested. Submerging stem cuttings for 60 min or more increased the likelihood that cuttings would be severely damaged or killed (Table 1).

## DISCUSSION

Sanitation is a proven first line of defense that generally is cost effective, and is important for limiting the occurrence of disease during propagation (Daughtrey and Benson, 2005; Jones et al., 2001; William-Woodward and Jones, 2001). Hot

water treatment is a form of sanitation and very effective in eliminating *Rhizoctonia* from azalea stems. Hot water treatment has not commonly been applied to stem cuttings, and has more commonly been applied to fruits, seeds, tubers, and vegetables. Due to the sensitivity of azalea stem cuttings to heat in these studies, hot water treatment should be restricted closely to 20-min submersion in 50 °C (122 °F). Based on published (but limited) research, many pathogens may survive this heat treatment, and only a few pathogens, such as some *Pythium* and *Phytophthora* propagules, may be detrimentally affected by this heat treatment. Research is needed to determine which pathogens would be killed by heat, if the depth of pathogen structures within plant tissue affects pathogen mortality, and if different types of heat act similarly.

Controls tend to work well against diseases that are shorter-term problems affecting primarily the current crop. Disease control tends to produce poorer results against pathogens that become established and persist at a greenhouse or nursery location. *Rhizoctonia* has established itself to the point that it is a coinhabitant with many azalea cultivars. Thus, it is not possible to collect cuttings from clean (*Rhizoctonia*-free) stock plants. We have shown that hot water treatment eliminates *Rhizoctonia* from stem cuttings. The next series of research projects will evaluate how to prevent *Rhizoctonia* from infesting clean plants during the entire multi-year production period, from propagation to sales. Although azalea web blight is not the most economically damaging problem, it has characteristics that favor its use as a model case for developing a systems approach that utilizes a combination of sanitation, cultural, and chemical controls. The objective is to reverse the pathogen's establishment success, as plants not infested with *Rhizoctonia* will not develop web blight. Future goals aim to determine if this high level of control can be used to deal with other, even more serious pathogens which currently cannot be controlled well. Good information is key to good management and making sound economic decisions.

#### LITERATURE CITED

- Copes, W.E.** 2004. Dose curves of disinfectants applied to plant production surfaces to control *Botrytis cinerea*. Plant Dis. 88:509–515.
- Copes, W.E.** 2009. Concentration and intervals of hydrogen dioxide applications to control *Puccinia hemerocallidis* on daylily. Crop Protection 28:24–29.
- Copes, W.E., and E.K. Blythe.** 2009. Chemical and hot water treatments to control *Rhizoctonia* AG-P infesting stem cuttings of azalea. HortScience 44:1370–1376.
- Daughtrey, M.L., and D.M. Benson.** 2005. Principles of plant health management for ornamental plants. Ann. Rev. Phytopath. 43:141–169.
- Jones, R.K., G.W. Simone, S.L. von Broembsen, and E. Dutky.** 2001. Integrated disease management, pp. 376–383. In: R.K. Jones, and D.M. Benson (eds.). Diseases of woody ornamentals and trees in nurseries. APS Press, St. Paul, Minnesota.
- William-Woodward, J., and R.K. Jones.** 2001. Sanitation: Plant health from start to finish, pp. 384–386. In: R.K. Jones, and D.M. Benson (eds.). Diseases of woody ornamentals and trees in nurseries. APS Press, St. Paul, Minnesota.