Sanitation Can Be a Foundation Disease Management Tool: Potential of Spreading Binucleate *Rhizoctonia* from Nursery Propagation Floors to Trays Containing Azalea Stem Cuttings©

Warren E. Copes
U.S. Department of Agriculture, Agricultural Research Service, Thad Cochran Southern Horticultural Laboratory, Poplarville, Mississippi 39470, USA
Email: warren.copes@ars.usda.gov

INTRODUCTION

Many people see sanitation as simple control techniques with limited application. However, a technical definition of sanitation is any control action that lowers the initial pathogen level so that the amount of final crop loss is reduced or a damaging threshold of disease is delayed. The resulting reduction in disease, whether from a single control action or integrated disease management, can be dramatic and desirable (Daughtrey and Benson, 2005; Jones et al., 2001; Williams-Woodward and Jones, 2001). Ultimately, pathogen reduction is a desirable goal that reduces the need for other controls or magnifies their effectiveness. The potential for pathogen reduction (sanitation) to be beneficial is greater in ornamental plant production than any other commodity system, yet this potential has not been imaginatively explored using current research concepts.

Binucleate *Rhizoctonia* species (BNR), the cause of web blight, are present all year on stems, in dead leaves below the canopy, and in the pine bark media of many container-grown azalea cultivars in the southern USA (Copes et al., 2011). Azalea shoots collected for stem cutting propagation can harbor the pathogen, thus allowing the pathogen to be carried into the propagation house. Temperature and moisture conditions in propagation houses are favorable for plant root development and pathogen growth, which allows *Rhizoctonia* to infest next year's crop. Copes and Blythe (2009) showed binucleate *Rhizoctonia* can be eliminated prior to vegetative propagation by submerging stem cuttings in 51°C (123°F) water for 21 min. Root development progressed normally for 12 azalea cultivars ['Conleb' (Autumn Embers), 'Fashion', 'Formosa', 'Gumpo White', 'Hardy Gardenia', 'Hershey Red', 'Macrantha Pink', 'Midnight Flare', 'Red Ruffles', 'Renee Michelle', 'Roblel' (Autumn Debutante), and 'Watchet'] receiving hot water treatment (Copes and Blythe, 2011).

Rooted cuttings are removed from propagation houses in the spring. Propagation managers typically remove organic debris and leave houses empty for 6 to 8 weeks before the next crop of stem cuttings are collected. The objective of the current study was to evaluate (1) the presence of *Rhizoctonia* on bare propagation floors, (2) survival of the pathogen over 6 weeks of exposure to full sun and ambient temperatures, and (3) risk of rooting trays with stem cuttings becoming colonized by *Rhizoctonia* present on polyethylene fabric and gravel floors in propagation houses.

MATERIALS AND METHODS

Experiment 1: Recovery of *Rhizoctonia* from Propagation House Floors

Polypropylene fabric and gravel floors of commercial propagation houses were sampled 1 to 7 days after trays with rooted cuttings were removed in 2011 and 2012. Recovery of binucleate *Rhizoctonia* from polyethylene fabric and gravel floors were sampled by rubbing a sterile damp synthetic sponge on the floor at 96 randomly selected spots from a defined grid layout. The sponge was placed in sterile tubes and plated on Ko and Hora agar in the laboratory. *Rhizoctonia* was identified by morphological traits and nuclei counted using a safarnin red staining procedure.

Experiment 2: Survival of *Rhizoctonia* over Six Weeks on Floors in Empty Propagation Houses
Fabric strips and gravel were inoculated with *Rhizoctonia*. Fabric strips were stapled to the bottoms of wooden frames. Gravel was set in wooden frames that had fabric bottoms. Both floor materials were exposed to factorial treatment combinations of (1) full sun or 70% shade, (2) ambient rain only or irrigation at 2-h intervals plus rain, and (3) free of organic matter or partially covered with peat. Substrates were sampled at 2-week intervals over 6 weeks and plated on Ko and Hora agar in the laboratory. *Rhizoctonia* was identified by morphological traits.

Experiment 3: Potential for *Rhizoctonia* to Grow from Infested Floor Surfaces into Trays Filled with Peat Where Stem Cuttings Are Being Rooted
Fabric strips (1/3 to 2.5 in. long) and gravel (1 to 6 pieces) were inoculated with *Rhizoctonia* and set beside or under rooting trays. *Rhododendron* 'Gumpo White' azalea cuttings were submerged in 51°C (123°F) water for 20 min, inserted in peat media for propagation, and placed under a daily 7-s mist duration at 15-min intervals from 7:00 to 19:00. Cuttings were maintained for 15 weeks, and then three cores of peat per tray were collected for isolation and plated on Ko and Hora agar in the laboratory. *Rhizoctonia* was identified by morphological traits.

RESULTS

Experiment 1: Recovery of *Rhizoctonia* from Propagation House Floors
Binucleate *Rhizoctonia* were recovered from 1 to 9% of 96 swab samples per an area containing a single cultivar on fabric floors and 3 to 9% of 96 swab samples per an area containing a single cultivar on gravel floors.

Experiment 2: Survival of *Rhizoctonia* over Six Weeks on Floors in Empty Propagation Houses
Absence or presence of peat and absence or 2-hour intervals of irrigation in addition to rain did not significantly influence *Rhizoctonia* survival. Binucleate *Rhizoctonia* recovery declined 75% under shade and 86 to 96% under full sun over 6 weeks.

Experiment 3. Potential for *Rhizoctonia* to Grow from Infested Floor Surfaces into Trays Filled with Peat Where Stem Cuttings Are Being Rooted
After 15 weeks, binucleate *Rhizoctonia* was not recovered from any trays regardless of inoculum level or placement. Of the inoculum placed beside and below the trays, *Rhizoctonia* was recovered from 60 and 94% of the inoculated substrates after 15 weeks in 2011 and 2012, respectively.

CONCLUSIONS
Binucleate *Rhizoctonia* does persist on fabric and gravel floors after rooted cuttings are removed from the propagation house. While the pathogen population declines over the 6 weeks houses are empty, some *Rhizoctonia* may still be viable. However, under normal rooting conditions, none of the *Rhizoctonia* grew into rooting trays in this study. Since *Rhizoctonia* is known to readily colonize dead azalea leaves, it is important to clean floor surfaces of organic matter. Once the organic matter is removed, the risk for rooting trays becoming contaminated appears to be low. Disinfestants are being evaluated for sanitizing floor surfaces of binucleate *Rhizoctonia*. Applications of disinfestants would be a precautionary step that likely is not needed, but would further reduce risk of contamination. With the results to date, the prospective looks favorable for producing azaleas free of binculeate *Rhizoctonia*. If this practice is followed, fewer infected plants will be present on the nursery each successive year that clean propagation material is generated. This approach could eliminate the need for fungicides to control web blight, although the fungus likely would never be totally eliminated from the nursery.

Research has not been done that identifies the predominate means by which *Rhizoctonia* is spread between container-grown azaleas on the nursery, thus the following discussion is speculative. Motorized pruning shears are likely a means for spread between blocks of azaleas. Advice would be to separately prune blocks of azalea that are infested with *Rhizoctonia* and those free of *Rhizoctonia*. Clean and sanitize pruners before pruning azaleas that are free of *Rhizoctonia*. Another possible means of spread is the dispersal of infested leaves during storms. A study is being considered to evaluate what wind speeds spread dead leaves colonized by *Rhizoctonia* across a nursery. Wind-blown leaves would probably result in small spread incidences, especially during severe storms. Natural means of spread are likely a key reason that *Rhizoctonia* cannot be totally eliminated from the nursery. Other means of spread could result from plant handling activities. As with pruning shears, the main concern is when working in plants free of *Rhizoctonia*. Hand washing and stiff brushes to remove organic debris from pants and boots may reduce the potential of this type of spread. One technique would be to schedule workers to complete work among plants free of *Rhizoctonia* first thing in the morning before work is done among other azaleas, hollies or any plant species that have had web blight symptoms.

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