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Compost Teas and Reused Nutrient Solution Suppress Plant Pathogens In Vitro

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***Abstract*. In vitro testing was conducted to evaluate the inhibition potential of three compost teas (pine bark, manure, and vermicasting), Root Rescue Landscape Powder® (a mix of mycorrhizae and other beneficial microbes), waste diatomaceous earth (DE; from beer brewing), and a greenhouse nutrient solution, which had been reused for 20 years on six plant pathogens: *Fusarium foetens*, *Rhizoctonia solani*, *Sclerotinia sclerotiorum*, *Phytophthora cryptogea*, *Pythium intermedium,* and *P. ultimum*. The test materials showed in vitro inhibition on most of the test pathogens. Pine bark tea suppressed growth of all six pathogens, and inhibition exceeded 50% after 10 days of coincubation. Vermicasting tea showed over 40% inhibition against *S. sclerotiorum* and *F. foetens*; manure tea showed 42% inhibition against *F. foetens*; DE showed 40% inhibition against *F. foetens*, *S. sclerotiorum*, and *R. solani*; whereas reused greenhouse nutrient solution showed 56.7% inhibition against *R. solani* and 43.4% inhibition against *F. foetens*; Root Rescue showed 66% inhibition against *P. intermedium.* The results suggest that the six test materials have potential in the control of these soil- and water-borne pathogens in plant production system.**

An increasing number of greenhouses are reusing nutrient solutions in their operations to protect the environment and save water and fertilizer (Richard et al., 2006). One major concern of this practice is the risk of dispersal of soil- and water-borne plant pathogens within the recirculation system (Richard et al., 2006). Various water disinfection technologies have been used in controlled environment plant production systems including greenhouse and nursery operations. However, these technologies are usually ineffective in controlling pathogens in potting substrates, especially when the substrates contain organic materials. For example, the frequently used oxidants (e.g., ozone, chlorine, and chlorine dioxides) may react with organic potting substrates before they reach residual levels that are lethal to plant pathogens. Similarly, control of plant pathogens with copper ion is also challenging because organic potting substrates can bind copper ions, preventing them from reaching critical levels for pathogen control (Zheng et al., 2004).

An alternative to nutrient solution disinfestation technologies in controlled environment plant production systems to reduce pathogen pressure in reused nutrient solution is the use of pathogen-suppressing growing substrates and the addition of beneficial microorganisms.

Compost teas (water extracts from the fermentation of compost materials) have been reported to act as natural pesticides and may contain various biopesticidal microbes and organic chelators (Scheuerell and Mahaffee, 2002). Using composted organic materials such as municipal wastes, hardwood bark, and vermicompost as soil amendments have been shown to reduce root rot diseases (Dissanayake and Hoy, 1999; Hoitink et al., 1991; Szczech, 1999; Trillas-Gay et al., 1986).

More than 10 yeast genera were used to control soilborne plant diseases (El-Tarabily and Sivasithamparam, 2006). Yeasts are required for beer brewing and are often removed, in conjunction with other unwanted solids, at the end of the brewing process by filtration through powdered DE. We are not aware of any work designed to investigate the potential of using liquid from DE slurry to control plant pathogens.

During a survey of the status of greenhouse nutrient solution recirculation in Ontario, Canada (Richard et al., 2006), it was found that some greenhouses had been reusing their nutrient solutions for more than 20 years without increased disease incidence. Microbiological analysis of some of these nutrient solutions did not detect any plant pathogens (data not shown).

The objective of this study was to evaluate the inhibitory potential of three compost teas (pine bark, manure, and vermicasting), Root Rescue Landscape Powder® (a mix of mycorrhizae and other beneficial microbes), waste DE from beer brewing, and a greenhouse nutrient solution that had been reused for more than 20 years on six water- or soilborne plant pathogens commonly found in Ontario greenhouses.

Materials and Methods

Inhibition subtracts used in trials. Three commercially available compost products, Root Rescue Landscape Powder® (Root rescue), waste DE, and a reused greenhouse nutrient solution (RNS) were used to test their inhibition potential on six soilborne plant pathogens. The three composts used were vermicasting (Forterra Environmental Corp., Puslinch, Ontario, Canada); manure compost (unknown quantities of cattle, sheep, and horse manures, onion and carrot scraps, and egg shells; Dingo Farms, Bradford, Ontario, Canada); and composted pine bark (passed through 6.4-mm mesh; GroBark, Milton, Ontario, Canada). The Root Rescue Landscape Powder® (Redbud Supply Inc., Ancaster, Ontario, Canada) contains nine species of endomycorrhizal fungi, 10 species of ectomycorrhizal fungi, *Trichoderma harzianum*, *T. konigii,* and 14 species of bacteria. The DE was collected as a waste material from a local beer brewery (Sleeman Brewery Ltd., Guelph, Ontario, Canada). The liquid portion of the waste was used for tests. The reused nutrient solution was collected from a holding tank in a commercial greenhouse in southwest Ontario, Canada, that had been recycling the solution for more than 20 years and no major plant pathogen outbreak had been reported during this period. In this greenhouse, potted ornamental plants were grown (e.g., *Campanula*, *Aphelandra*, *Gerbera*, and others) on subirrigation benches. Compost tea was prepared using a Compost Tea System (Compost Tea System25™, Eugene, OR). Briefly, the compost tea system was filled with deionized water, the compost basket immersed into the water tank, and a bubble stone placed into the tank to start the brew cycle. The tanks were continually aerated and the compost tea thoroughly mixed before dispensing. The brew cycle was 24 h.

Plant pathogens. The plant pathogenic microbes tested were commonly found in greenhouse crops: *F. foetens, R. solani, S. sclerotiorum, P. intermedium, P. ultimum*, and *Phytophthora cryptogea*. Before inoculation, *F. foetens, R. solani*, and *S. sclerotiorum* isolates were grown on potato dextrose agar (PDA) in petri plates with a diameter of 90 cm; *Pythium intermedium, P. ultimum*, and *Phytophthora cryptogea* were subcultured onto V8 medium and incubated at room temperature until the mycelium fully covered the entire agar surface.

Evaluation of microbial population in solutions. The population densities of bacteria, filamentous fungi, yeasts, and actinomycetes were evaluated in all tested samples. The samples were serially diluted in water with five dilutions: 1:10, $1:10^2$, $1:10^3$, $1:10^4$, and $1:10^5$. A 100-µL solution of each sample was spread onto three media in petri plates as follows: one-tenth trypticase soy agar, colloidal

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