Control of Soil Borne Pathogens in Greenhouse Production

PRINCIPAL INVESTIGATOR:
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PROJECT OBJECTIVES:
Avoidance of root diseases was one of the primary motivating forces underlying the development of soilless agriculture. Although cultivation in soilless systems has resulted in a decrease in the diversity of root-infecting pathogens compared with conventional culture in soil, root diseases still occur. Most of the destructive root diseases in soilless culture have been attributed primarily to zoosporic, fungi-like species (oomycetes) in the genus *Pythium* and *Phytophthora.* Thus, knowledge of the avenues of pathogen introduction is requisite for maintaining a pathogen-free environment. Once pathogen introduction and root infection has occurred, management is often difficult because pathogen reproduction in the roots of an infected plant will provide a continuous (24/7) source of abundant new inoculum for rapid dispersal throughout the system via the recirculating nutrient solution.

The specific objectives relative to the overall goal was to (1) identify the role of fungus gnats and shore flies as vectors of soil-borne root-infecting pathogens and (2) assess the efficacy of chemical amendments to the recirculating nutrient solution in the management of root diseases once pathogen introduction has occurred.

ACCOMPLISHMENTS:
(1) We established that adult shore flies and fungus gnats, which we previous documented as capable of serving as aerial vectors of several root-infecting plant pathogenic fungi (i.e., *Fusarium, Verticillium and Theilaviopsis*), cannot serve as aerial vectors of either *Pythium* or *Phytophthora*. However, larval stages of these two insects, in addition to snails, can ingest and excreted viable life stages of both *Pythium* and *Phytophthora*. Although these greenhouse pests (larvae and snails) may not contribute to the rapid spread of these oomycetes compared to dispersal of true fungi by adult flies, they may play a role in the initial introduction of the pathogen into a production facility via infested cuttings and horticultural substrates. Once introduced, these oomycetes could be dispersed rapidly by the recirculating irrigation water.

(2) We isolated and identified a strain of *Beauveria bassiana* as an entomopathogen of shore flies and fungus gnats and developed it as biospesticidal bait for delivering the entomopathogen to insect-infested sites in greenhouses. Over the past 3 years, the biospesticidal bait has been evaluated in commercial plant product facilities and has proven effective in pest control in one of three trials.

(3) We previously reported that N-Serve and Dwell (i.e., nitrification inhibitors), when added to the re-circulating nutrient solution in hydroponic systems, caused a surge in the total and indigenous fluorescent pseudomonad population which, either directly or indirectly, coincided with suppression of disease caused by a root-infecting zoosporic pathogen. In our ongoing search for additional and perhaps more efficacious amendments for management of zoosporic

pathogens in re-circulating systems, we evaluated the efficacy of the following chemical amendments to the nutrient solution: zinc oxide, xylene, Actigard®, Neem, Perasan®, and sodium salicylate.

With the exception of sodium salicylate, none of the other chemical amendments to the nutrient solution (i.e., Neem, Perasan®, xylene, zinc oxide, or Actigard® (which was extremely phytotoxic) provided either consistent or significant control of the disease. All chemical amendments, except Perasan®, enhanced the total and the fluorescent bacterial population in the nutrient solution. However, the selective enhancement of the fluorescent pseudomonad population (which consisted of several biotypes) varied dramatically (0 to 87 percent) following each consecutive addition of sodium salicylate to the nutrient solution. Thus, the role of fluorescent pseudomonads in disease suppression is unknown. This study, however, demonstrates, for the first time, the potential use of sodium salicylate as an amendment to the recirculating nutrient solution for the control of zoosporic root-infecting pathogens. The consistent delay in both the onset and the severity of disease achieved in the extreme pathosystem we used, i.e., peppers versus *P. capsici* - a worst case scenario, suggests that even higher levels of disease management are probable in the more common and less destructive host-pathogen combinations which occur in commercial production of crops cultivated in recirculating hydroponic systems.

TECHNOLOGY TRANSFER/IMPACT: MAJOR PUBLICATIONS.

Pagliaccia, D., Ferrin, D, and Stanghellini, M.E. 2007. Chemo-biological suppression of root-infecting zoosporic pathogens in recirculating hydroponic systems. Plant Soil 299:163-179.

Pagliaccia, D., D. Merhaut, M.C. Colao, M. Ruzzi, F. Saccardo, and M. E. Stanghellini. 2008. Selective enhancement of the fluorescent pseudomonad population after amending the recirculating nutrient solution of hydroponically-grown plants with a nitrogen stabilizer. Microb. Ecology 56:538-554.

Hyder, N., Coffey, M. and Stanghellini, M.E. 2009. Viability of Oomycete propagules following ingestion and excretion by fungus gnats, shore flies, and snails. Plant Disease 93:720-726.

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