Control of Plant Parasitic Root Diseases and Nematodes in Ornamental Production Systems

PRINCIPAL INVESTIGATOR:
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PROJECT OBJECTIVES:
This project examines how slow sand filtration (SSF), a biological treatment system, can be used to remove root diseases and parasitic nematodes from captured runoff water for reuse to irrigate greenhouse and nursery grown plants. A SSF system is relatively inexpensive to install, simple to operate, and relatively easy to maintain. There are several aspects of this project: 1) optimize slow sand filtration by determining the maximum rate of filtration while still maintaining effective removal of plant pathogens; 2) determine if a SSF system established against *Phytophthora capsici* can be effective in removing *P. ramorum*, a different although related disease-causing organism; 3) determine the ability of SSF systems to remove nematodes from runoff water; 4) characterize the biological components of the system; 5) determine if coupling with other biological treatment (portable wetlands) or UV systems can enhance treatment efficacy; and 6) demonstrate system operation at commercial growing sites.

ACCOMPLISHMENTS:
One set of completed experiments tested the efficacy of slow sand filters (SSF) at different flow rates in removing plant pathogens from irrigation runoff. A second examined the ability of the SSF biofilms established in the presence of a specific pathogen to remove other pathogens. The SSF system utilized 2 m tall columns of 4" diameter PVC pipe filled with 1 m of 60 mesh blasting sand exposed to captured runoff inoculated with *Phytophthora capsici*.

To test flow rates, runoff through 15 columns was controlled at three different rates equivalent to 150, 250, and 500 L/m^2•hr. A total of 180-500 mL samples were collected every 5 days for 30 days beginning the day runoff was introduced to the freshly constructed sand bed (day 0) for a total of seven sampling events. Samples were collected at positions just above the sand (pre-treatment), at 20cm intervals down the sand bed, and below the bed (post-treatment). An aliquot of each sample was filtered through 22 µ filters. Smaller volumes of pre-treatment samples were filtered due to the greater number of zoospores. Filters were plated onto PARP agar to inhibit growth of non-*Phytophthora* species. After several days, the number of colony forming units (CFU) of *P. capsici* on the plates were counted. This experiment was repeated three times during the spring (May), winter (November-December), and summer (July-August).

Data show that the biofilms required about 20 days to establish and thereafter removed nearly 100 percent of the pathogen from the runoff. The winter experiment revealed that there may be physical filtering beginning at day 0, perhaps due to the combination of pumping agitation and low temperatures causing the zoospores to aggregate and become trapped in the top layer of the sand.

To study the ability for SSFs established on *P. capsici* to remove other species of *Phytophthora*, five columns were established at UC Davis using runoff inoculated with *P. capsici* flowing at 150 L/m^2•hr as described previously. Five additional columns were simultaneously established using water from Lompico Creek (Felton, California) known to contain *Phytophthora sp.*, including *P. ramorum*. Pre-treatment and post-treatment water samples were collected from all columns, along with two samples of stream water, every week for 6 weeks. After 4 weeks, the five columns at UCD were moved to Felton and fed stream water. Sampling continued for 2 more weeks to compare the 10 columns. Pear-baiting was used to determine the number of infecting zoospores in each sample. Lesions were plated onto PARP agar and *Phytophthora* species were identified under microscopy. When necessary, colonies were isolated onto V8 agar or PARP to confirm identification. This experiment was conducted twice.

Data indicate that the SSFs established in Felton took about a week longer to establish on the biofilm than the set at UCD. In both trials the columns established at UCD maintained about 100 percent removal of *Phytophthora* after relocation to Felton. The columns established in Felton exhibited problems maintaining flow due to plugging. Treating turbid water is problematic for SSFs and further research investigating pre-filtration is necessary to optimize them for nursery use.

TECHNOLOGY TRANSFER/IMPACT:

This project has expanded the awareness of slow sand filtration to growers as a method to treat runoff. Presentations have been made to national and regional grower groups as well as UC Cooperative Extension meetings. Proposals for future national water quality meetings for greenhouse and nursery growers include presentations on SSF systems.

ADDITIONAL FUNDING/EXTERNAL SUPPORT:

These experiments were initiated with grants from the California Association of Nurseries and Garden Centers and the Fred C. Gloeckner Foundation. The USDA FNRI support allows us to complete these trials, initiate studies on the biological processes involved with treatment, test methods to pretreat turbid runoff, demonstrate the usage of SSFs, and involve researchers from the University of California Cooperative Extension in Southern California and the University of Washington College of Forest Resources.

COLLABORATORS:

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