Integrated Management of Zoosporic Pathogens and Irrigation Water Quality for a Sustainable Green Industry

Progress Report

(9/2011-8/2012)

Outputs

This project had an exciting and productive second year. 1) Continued water sampling in AL, MS and PA has resulted in discovery of several new Phytophthora and Pythium species. 2) Two new species Phytophthora aquimorbida and Phytophthora taxon “aquatilis” were formally named and they were also evaluated for pathogenicity to rhododendron. 3) The hypotheses that we put forward in 2009 on water quality dynamics in agricultural irrigation reservoirs were tested with the new data from five nurseries across the mid-Atlantic region. Water quality relations to nutrient influx into the reservoirs and surrounding weather conditions were also investigated. 4) Among three high-impact pathogens assessed for zoosporic responses to water pH and electrical conductivity, P. ramorum is most adapted to agricultural water environment compared with P. alni and P. kernoviae. This research has been expanded to include other pathogens and water quality parameters. 5) Through an internship, the “wet-plate” method for mass zoospore production was improved and defined of its applications. 6) Diverse bacterial species were identified from both greenhouse and nursery irrigation water; selected species and strains are being evaluated for their biocontrol potential. 7) Some of the new Pythium species found repeatedly in recycling greenhouse irrigation water are non-plant pathogenic but may inhibit the survival and activity of highly pathogenic species of Pythium. 8) Current heat treatment protocol was re-examined consequently a new treatment temperature and time combination has been proposed for greenhouse applications to improve the economics and reduce the environmental footprint. 9) After consultation with collaborating growers and advisory panel members as well as other industry professionals, a survey was developed on consumer preference for ornamental plants with disease-free and water conservation labels. This survey was administered by qSample to 14,175 individuals with gardening interest in MD, PA, VA and GA. The resultant 1,596 usable surveys were analyzed and written in a thesis. 10) A producer survey is being developed on water recycling and disease control practices, and the associated economics. 11) To complement the proposed project activities, current knowledge on biology and management of plant pathogens in irrigation water was synthesized in a 30-chapter book in collaboration with 49 world leading scientists. As a result, our research consortium also has expanded to cover vegetables, tree fruit and nut crops, and to have a global focus. 12) The knowledge center has been established as part of eXtension and three learning modules have been developed. 13) Our research updates were disseminated through organization of a session at the 7th International IPM Symposium in Memphis, TN on March 27, 2012, and sixteen presentations at national and international extension and outreach venues. 14) Five graduate students, two summer interns from a medium-sized college in Newport News, VA, and one high school senior from an International Baccalaureate Program in Virginia Beach, VA, were mentored. 15) Industry support increased in research grant and in-kind contribution.
Outcomes/Impacts

As illustrated in two theses, eight refereed journal articles, two conference papers and six abstracts, this project has advanced the science and technology in a broad range of disciplines from biology to agricultural engineering and economics. Each of these advancements provides a basis for technology innovation and development of an integrated approach to zoosporic pathogens and irrigation water quality for more profitable and sustainable green industry. Some of these findings have already been incorporated into the practices at collaborating nurseries and greenhouses as well as a few early adapters, resulting positive impacts. This is exemplified by a change in heat pasteurization practice in a greenhouse that recycles 500 liter of water for irrigation per day under an ambient temperature at 20°C. The energy required to raise and maintain water temperature at 95°C for 30 seconds per the current heat treatment protocol is 148,500 British thermal units (Btu), neglecting the heat loss during treatment. Comparatively, per new protocol resulted from this project, only 55,000 Btu is needed to raise the water temperature to 48°C, and an additional 10,748 Btu to maintain at this temperature for 24 hours according to the minimum energy performance standard (MEPS and Labeling Requirements, 2005). Switching from the current heat treatment practice to the new protocol would cut the energy consumption by half (55%) in this greenhouse operation. The immediate benefits of such a switch are reduced production cost and environmental footprint, improving the profitability and promoting the “green” status of this green industry. This new protocol also has several other benefits which could further improve its economics and reduce the environmental impact. It enhances bacterial activities against plant pathogens, thus improves its compatibility with other disease control strategies in particular of biological control. It also opens the possibility to use solar, geothermal and possibly other alternative energy sources. The overall potential benefits of implementing the resultant findings and novel technologies from this project are enormous on a national scale. Particularly, the benefits of using better design for new recycling irrigation systems and modifying the existing systems to prolong irrigation runoff water turnover time will be everlasting and multifaceted. With these new technologies and practices, growers will be able to reduce crop losses consequently produce more and better quality horticultural products at reduced energy consumption, fungicide and water usage, improving their profit margin and public image. Disease-free ornamental plants produced with water conservation practices may be marketed and sold at greater prices while adding to the consumer satisfaction. These additional benefits, in turn, will put the horticulture industry on an even faster track to great profitability and sustainability.

Publications

17. Yang, X., and Hong, C. X. 2012. Isolation of *Phytophthora* and *Pythium* species from different depths of sediments in a runoff water sedimentation pond of eastern Virginia. Phytopathology 102:S4.140

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**Target Audience**

Growers,
diagnosticians and field responders,
extension specialists and agents,
crop health care professionals, microbiologists, mycologists, bacteriologists, horticulturists and irrigation specialists, conservation biologists, and policy-makers