

Title: A rapid response system for prediction and management of Phytophthora diseases in Massachusetts farms using risk mapping and real-time PCR.

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Project Overview

Phytophthora species consistently rank as some of the most devastating disease agents in Massachusetts farms. Two species, *P. infestans* and *P. capsici*, attack regionally important vegetable crops, including cucurbits, peppers, tomatoes, eggplant and potatoes. In 2007, over 8,000 acres of vegetable crops susceptible to infection by *P. capsici* and *P. infestans* were harvested in Massachusetts. Both species are exotic to New England, and have been responsible for disease outbreaks that have resulted in losses totaling hundreds of thousands of dollars in damages. In 2009, an outbreak of *P. infestans* in the northern U.S. and eastern Canada devastated tomato and potato crops. In subsequent years, damage from *P. infestans* was minimal, until 2012 when another severe outbreak affected area tomato crops. The 2009 outbreak was caused by two unique genotypes of *P. infestans*, which differed in virulence, host preference, and fungicide resistance.

These outbreaks have highlighted the need to determine the incidence of *Phytophthora* in Massachusetts farms, and for the development of a rapid disease response system that could accurately identify clonal lineages, new outbreaks, and also predict areas that are most likely to support disease development. The rapid detection of clonal lineages would allow more effective fungicide recommendations. Current disease forecasting models for *Phytophthora* have been developed for use over large areas, and do not incorporate case-history information or site-level monitoring. While these forecasting models have enormous utility, they cannot provide the resolution required to adequately predict disease outbreaks at the farm-scale in Massachusetts. The most fundamental component for an effective risk map, and often the most difficult to obtain, is accurate data on the current distribution of the targeted pathogen. Without this foundation, risk maps cannot accurately predict where and how a pathogen may spread and management plans often fail to meet their objectives.

Activity Summary – 2014

- Presentations and abstracts at professional meetings (2)
- Printed reports available to area farmers (1)
- Web-based content available to area farmers (1)

Total Educational contacts

	Adult Contacts
In Person	100
Indirect Contacts (Print, Web, etc...)	

Narrative Summary and Impact

Phytophthora species were surveyed at 20 sites in Massachusetts, with 17 occurring in the Connecticut River Valley. Many of the sampled waterways were adjacent to active agricultural lands, yet were buffered by mature floodplain forests composed of *Acer*, *Platanus*, *Populus* and *Ulmus*. Isolates were collected using three types of baits (rhododendron leaves, pear and green pepper) in 2013 and water filtration through 5 µM membranes in 2014. Overall, 453 isolates of *Phytophthora* were baited and based on morphological characters and DNA sequences (ITS, β-tub and cox1), 18 taxa were identified and include (in decreasing order of abundance): *P. hydropathica*, *P. irrigata*, *P. plurivora*, *P. taxon PgChlamydo*, *P. gonapodyides*, *P. lacustris* and *P. lacustris* × *riparia*, *P. taxon intercalaris*, *P. citricola* III, *P. pini*, *P. citrophthora*, *P. ×stagnum*, *P. stricta*, *P. citricola* MA, *P. hydrogena*, *P. borealis* sl, *P. macilentosa*, *P. polonica*, and *P. taxon personii*. In addition, 49 isolates representing five species of *Phytophthora* (*P. litorale*, *P. vexans*, *P. mercuriale*, *P. citrinum* and *P. sp.*) were also recovered. Water filtration captured a greater diversity of species compared to leaf and fruit baits. Of the three bait types, rhododendron leaves collected the greatest number of isolates and species, followed by pear and green pepper, respectively. Despite the proximity to agricultural lands, none of the *Phytophthora* species baited are legitimate pathogens of vegetable crops in the region. Four species in the *P. citricola sensu lato* complex were identified: *P. plurivora*, *P. citricola* III, *P. pini*, and a putative novel species, referred to here as *P. citricola* MA. To determine the host specificity of *P. citricola* MA, one-year-old twigs from 12 potential host tree species, representing nine genera, were under-bark inoculated and assessed for lesion formation. Inner bark and sapwood lesions were detected only on species of *Carya* and *Juglans*, and the pathogen was re-isolated from stained sapwood tissue. Inoculation trials on *Carya* and *Juglans* saplings will take place to confirm the preliminary results and fulfill Koch's postulate. *Phytophthora plurivora* is a non-native pathogen in North America and has been recently associated with forest decline events in Europe. The non-native vegetable pathogen, *P. capsici*, was collected from several sites in 2013 and 2014 during outbreaks of the disease on cucumber, peppers and several varieties of squash. Baiting attempts from soils in the immediate vicinity of diseased crops were successful in isolating the pathogen. However, the pathogen could not be baited from waterways adjacent to infested fields, suggesting that movement of the pathogen is restricted to major flooding events and contaminated equipment (e.g. tractor tires and plows). Using a collection of over 250 *P. capsici* isolates collected from 1997 to 2014, the population structure is being assessed using a genotyping by sequencing (GBS) approach. The results will illustrate how the local population is structured in the Connecticut River valley and shed light on possible modes of pathogen dispersal. The results illustrate a high level of native and non-native *Phytophthora* species diversity in the Connecticut River Valley.

Collaborating Organizations

The following farms in Massachusetts provided access for site survey or diseased plant samples for analysis:

1. Stone Soup Farm, Next Barn Over and Czajkowski Farm of Hadley
2. Simple Gifts Farm of Amherst
3. Kitchen Garden Farm of Sunderland
4. Atlas Farm and Melnik/Bars Farm of Deerfield
5. Mountain View Farm of Easthampton
6. Red Fire Farm of Granby
7. Harvest Farm of Whately

8. Foppema's Farm of Northbridge
9. Nuestras Raices Farm of Holyoke
10. Powisset Farm of Dover
11. Allen Tree Farm of Westfield
12. Cranston Tree Farm of Ashfield