



Analysis of Critical Control Points Within GAIP Nurseries 8/26/11

In the fall of 2010, the Oregon Department of Agriculture received a Specialty Crops Grant to conduct a study within nurseries participating in the Grower Assisted Inspection Program (GAIP). Nurseries participating in the GAIP are required to adopt best management practices (BMP) for critical control points (CCP) where the pathogen *Phytophthora* can be introduced into the nursery. This study concentrated on used containers, irrigation water, soil substrate, and potting media.

The goal of the study was to determine the presence or absence of *Phytophthora* at these four CCP in the GAIP nurseries and to provide feedback to the nurseries on the efficacy of the specific BMP adopted by each nursery for those CCP. This report provides a summary of the findings within all nurseries participating in the study. It also looks at the results compared to specific BMP adopted by the nurseries.

Sampling strategy

Samples were collected from irrigation water, potting media, and used containers to determine the presence or absence of *Phytophthora*. Samples were collected from these CCP once during the growing season and processed in the laboratory using USDA-approved soil and water baiting techniques for the detection of *Phytophthora*. *Phytophthora* detected were identified to genus level only.

Samples were also collected to determine the presence or absence of *Phytophthora* within each nursery's soil substrate. Depending upon its size, a specific number of transects were walked within each nursery. Locations for transects were chosen randomly by the inspector. Three survey plots were located equidistant along each transect, with one subsample of soil collected per survey plot and the three subsamples per transect combined into one composite sample for testing. The USDA-approved soil baiting technique was used to detect *Phytophthora* within each composite sample.

Nursery information

A total of 13 nursery locations, each with unique BMP for the CCP (Tables 1-3), were surveyed in this study. None of the nurseries listed BMP that were specific for the soil substrate, although several had practices listed for the other CCP that would also affect the *Phytophthora* population in the soil substrate.

The nurseries in the study covered a wide range of sizes, with three 5 acres or less in size, five between 10-100 acres, four between 100-500 acres, and one

>500 acres. Most were located in the Willamette Valley.

Table 1. Best management practices adopted by nurseries participating in the study for the irrigation water critical control point.

Nursery	Well water	River water	Recycle water	Treated water		Water tested
				Chemical	Biological	
A1	✓					
B1	✓		✓	✓		
C1		✓	✓			✓
D1	✓	✓	✓*			✓
E1	✓					
F1		✓	✓	✓		
G1	✓					
H1			✓		✓	
H2			✓	✓	✓	
H3	✓		✓			✓
I1	✓	✓				✓
J1	✓	✓	✓			✓
K1	✓	✓		✓		

*Run-off is directed to a non-recirculated pond.

Table 2. Best management practices adopted by nurseries participating in the study for the potting media critical control point.

Nursery	Media stored on			Equipment		Media		Used media steamed
	Concrete pad	Barrier type		Dedicated	Cleaned	Tested	Bagged	
		Gravel	Barack					
A1	✓		✓	✓	✓	✓	✓	
B1	✓							
C1	✓			✓				
D1	✓				✓			
E1			✓			✓		
F1					✓		✓	
G1		✓			✓	✓		
H1	✓			✓	✓			
H2		✓		✓	✓	✓		
H3		✓		✓	✓	✓		
I1	✓			✓	✓			✓
J1	✓				✓	✓		
K1	✓				✓			

*Nursery does not re-use used potting media from dead plants.

Table 3. Best management practices adopted by nurseries participating in the study for the used containers (pots) critical control point.

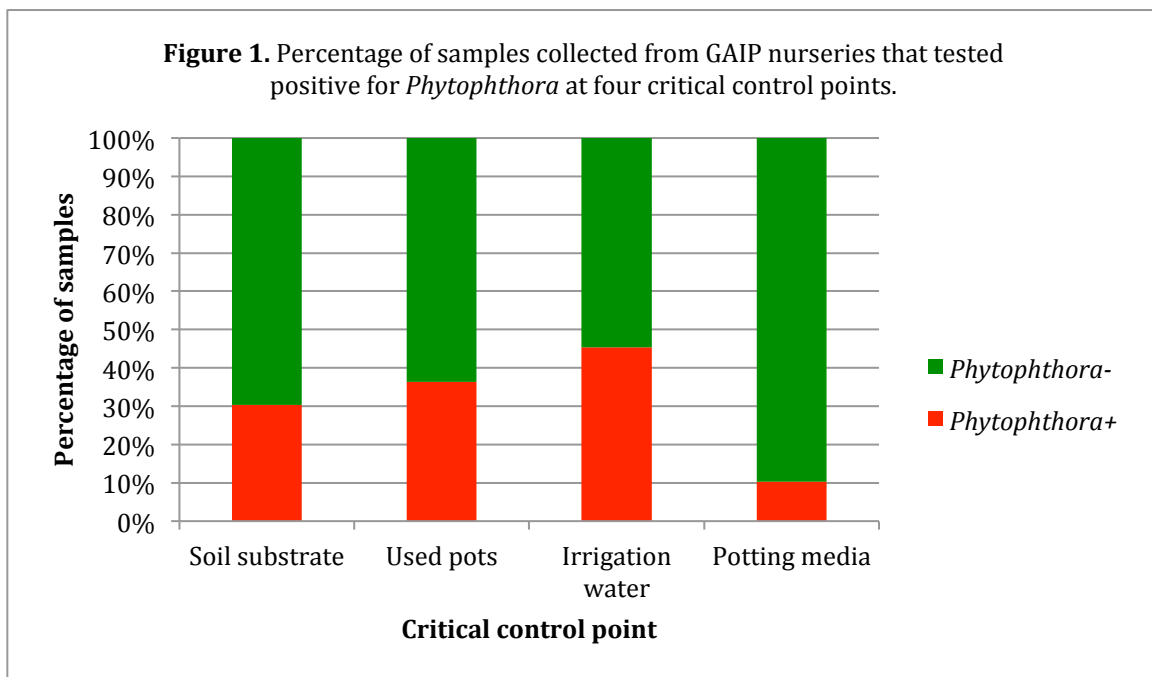
Nursery	New pots only for HAP*	Used pots			
		Recycled	Steamed	Sanitized	On non-HAP only
A1		✓	✓	✓	
B1	✓		✓	✓	
C1	✓	✓			
D1	✓				
E1	✓		✓		
F1	✓				
G1	✓			✓	

H1	✓		✓	✓	
H2	✓		✓	✓	
H3	✓		✓	✓	
I1	✓			✓	
J1	✓				✓
K1	✓	✓			

*HAP is an acronym used by USDA APHIS to mean host and associated host plants of *Phytophthora ramorum*.

Survey results

A total of 354 samples were collected from all CCP for this study. About 30.2% of all samples tested were *Phytophthora*-positive. *Phytophthora* was detected from each CCP tested, although it was detected most often in irrigation water based on the percentage of samples testing positive for *Phytophthora* (Figure 1).



When looking at the number of nurseries with *Phytophthora* present in at least one sample from a CCP, soil substrate and irrigation water were the most likely sources of potential *Phytophthora* contamination, with potting media the least likely source (Figure 2). One nursery had no *Phytophthora* detected in their soil substrate samples, while nine nurseries had no *Phytophthora* detected in their potting media samples.

A total of 44 water samples were collected for testing, with *Phytophthora* detected in 20 samples. When examined by water source, no *Phytophthora* was recovered from samples taken directly from well water (Figure 3). River water and water in recycling or other types of ponds were much more likely to have *Phytophthora* detected.

Figure 2. Percentage of nurseries with a *Phytophthora*-positive sample from each critical control point.

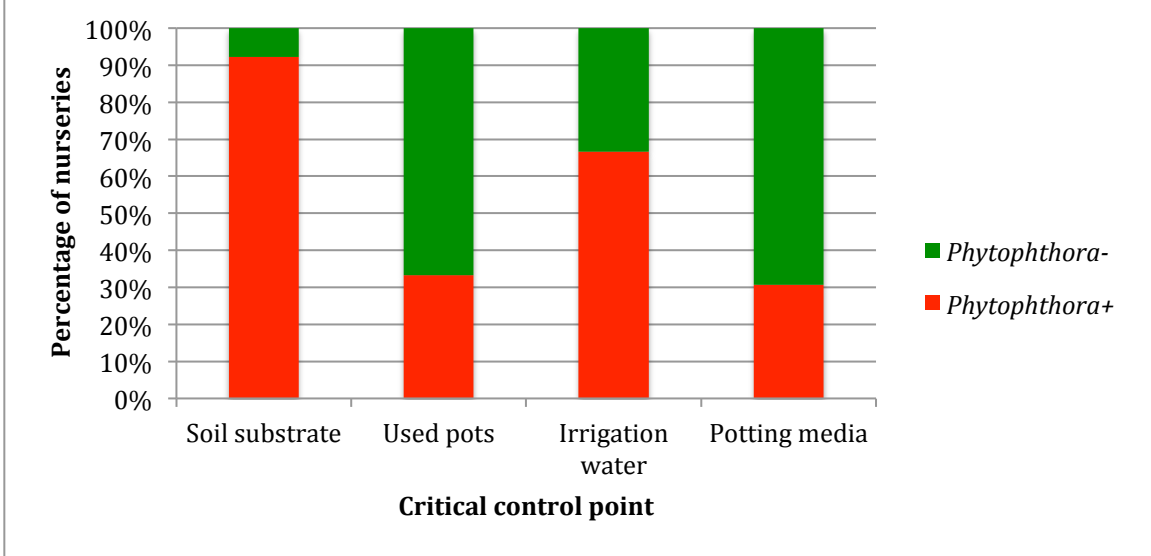
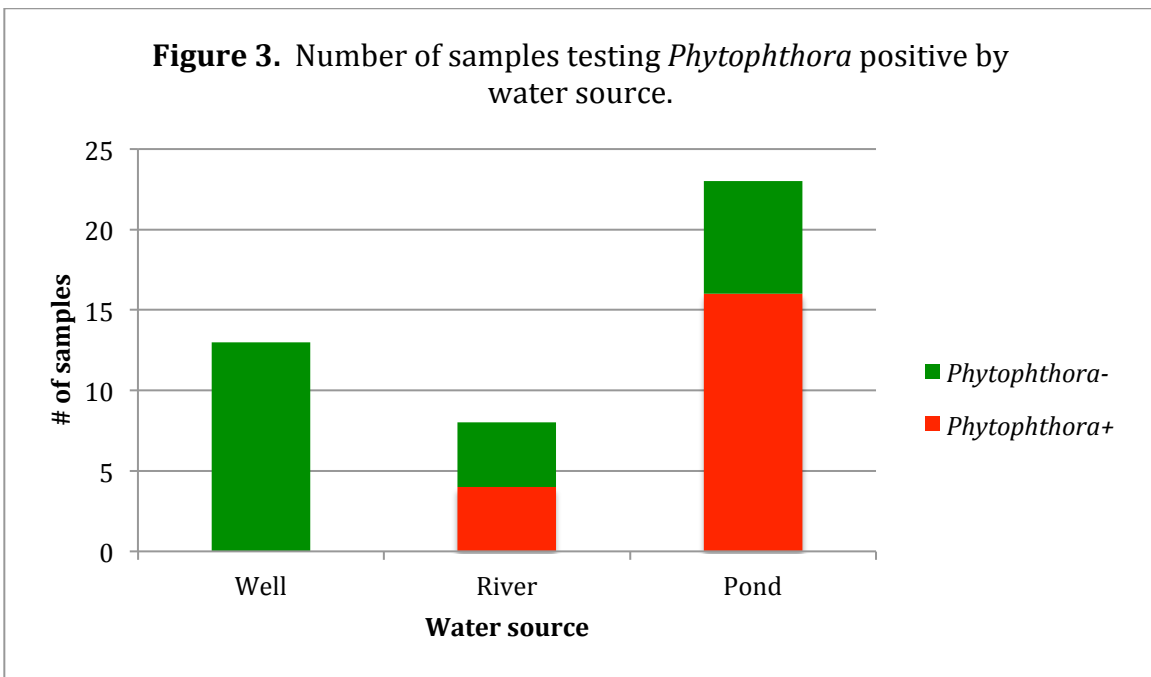


Figure 3. Number of samples testing *Phytophthora* positive by water source.



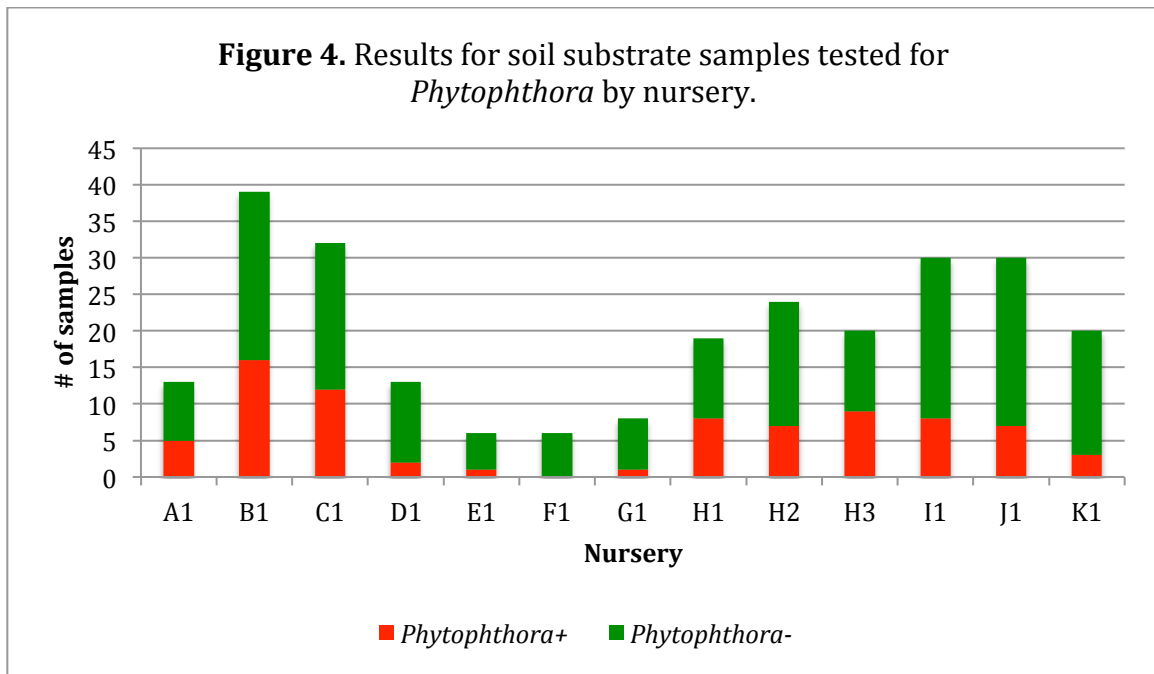
The majority of samples collected for testing were from the soil substrate. A total of 260 samples were collected, with 30.4% of all samples testing positive for *Phytophthora* (Figure 4). One small nursery (≤ 1 acre in size) had no soil substrate samples test positive. With that exception, all nurseries had *Phytophthora* present in the soil substrate along one or more transects within their nursery.

Eleven samples were collected from used containers. Of these, four were positive for *Phytophthora*, with one positive detected after the pots had reportedly been sterilized. The remaining positive samples were from untreated pots.

A total of 39 samples were collected from potting media, both individual components and mixtures, at the 13 nurseries. *Phytophthora* was detected in four of the samples. The only sample collected from media stored on a bark layer only tested positive. Two of eight samples collected from media stored on a gravel/media layer tested positive. One sample out of 27 collected from media or components stored on a concrete pad tested *Phytophthora*-positive.

Summary

The results of this study verify the CCP identified previously by Drs. Jennifer Parke and Nik Grünwald as sources of *Phytophthora* contamination within nurseries; *Phytophthora* was detected in the soil substrate, irrigation water, used pots, and potting media. The results also indicate that certain BMP appear to be more effective at mitigating the risk of *Phytophthora* entering a nursery through a particular CCP than others.



No *Phytophthora* was detected in any of the well water samples taken, indicating this is a safe source of irrigation water for nursery stock. In contrast, nurseries that irrigate with river water or water from recycling or another type of pond (pond water) run the risk of spreading *Phytophthora* to their plants. This is true even if the original source of water was a well; once the water enters a pond, it can become contaminated. We collected the water samples in the winter, when most nurseries depend upon rain to irrigate their plants. Nurseries that chemically or otherwise treat their pond water often don't treat in winter for that very reason.

However, when those nurseries begin irrigating from pond water in the summer, the treatments if done properly should mitigate the risk from *Phytophthora*. Nurseries that do not treat their pond water or irrigate directly from the river run the risk of spreading *Phytophthora* to their plants via contaminated irrigation water.

To minimize the risk of *Phytophthora* spreading within a nursery via irrigation water, develop a water management plan. There are four key components to such a plan: 1) Use water that is free of *Phytophthora* spores; 2) Avoid prolonged periods of wetness; 3) Apply water uniformly and according to water needs; and, 4) Prevent standing water and encourage drainage to remove excess water from root systems. Options for ensuring water is free of *Phytophthora* spores including using well water, treating with chlorine, treating with ozone, or treating with heat. Even if treatment is not possible, following the other three steps of the water management plan will reduce the risk of disease. *Phytophthora* is a water-dependent pathogen; managing the environment to minimize excess water will decrease its ability to cause disease.

Soil substrate has been identified before as a source of *Phytophthora* contamination for nurseries. Our study verified those previous results. With one exception, every nursery had *Phytophthora* present along at least one transect. Examples of sources of contamination for soil substrate include contaminated irrigation water, fallen leaves and diseased plants, and plant debris or contaminated soil coming in on vehicle tires or workers' shoes. There are several practices that will help minimize *Phytophthora* population levels in the soil: 1) Remove fallen leaves and diseased plant debris promptly from propagation and production areas; 2) Place pots on raised beds or a >4" gravel layer rather than directly on native soil; 3) Provide adequate drainage to prevent standing water and/or soil saturation; 4) Place your cull pile away from production, propagation, and potting areas; 5) Rotate crops on a particular site between plants that are *Phytophthora*-susceptible and –resistant; and, 6) Destroy diseased plant material or compost it to EPA standards (<http://www.epa.gov/osw/conservation/rrr/composting/science.htm>).

Although only 11 samples were collected from used containers, over 1/3 were positive for *Phytophthora*. This verifies previous reports from Parke and Grünwald that used pots were a source of *Phytophthora* in nurseries. The BMP adopted by the nurseries in the GAIP should provide adequate risk mitigation for this CCP. The greatest concern was the detection of *Phytophthora* from a used container after the container had reportedly been steam sterilized. This indicates the time/temperature regimen reached during steam sterilization was inadequate for this particular batch of pots and underscores the need for careful monitoring of time and temperature during the steam sterilization process. Likewise, nurseries using a disinfectant to sanitize pots must follow the label accurately to ensure the treatment is applied effectively.

Phytophthora was detected in very few potting media samples. One of the recommendations from the Oregon State University *Phytophthora* online course (<http://ecampus.oregonstate.edu/phytophthora>) is to ensure native soil (soil substrate) does not mix with potting media or its components. Three of the four *Phytophthora*-positive potting media samples were stored on barriers other than concrete; one was stored on bark and two others on a gravel/media mixture. One pumice sample stored on concrete was positive for *Phytophthora*. However, the nursery with that positive sample could have contaminated the pumice via dirty equipment. Nurseries that stored media on a concrete pad and used either dedicated equipment for potting or cleaned the equipment before potting had no issues with *Phytophthora* in their media.

The results of this study underscore the importance of these CCP as sources of *Phytophthora* contamination within nurseries. It also highlights BMP that effectively mitigate the risk presented by each CCP. Although all four CCP are important, directing resources at irrigation water and soil substrate may provide the greatest opportunity for risk mitigation in nurseries with limited resources.

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