

# Verifying Critical Control Points for *Phytophthora* Introduction into Nurseries<sup>1</sup>

N.K. Osterbauer,<sup>2</sup> M. Lujan,<sup>2</sup> G. McAninch,<sup>2</sup> A. Trippe,<sup>2</sup> and S. Lane<sup>2</sup>

## Abstract

The Oregon Department of Agriculture implemented the Grower Assisted Inspection Program (GAIP) for nurseries in 2007. Participants in GAIP adopted best management practices (BMP) for five critical control points (CCP) (used containers, irrigation water, soil substrate, potting media, and incoming plants), where foliar *Phytophthora* can be introduced into nurseries. The goal of this study was to determine the presence or absence of *Phytophthora* at four CCP in GAIP nurseries 3- to 4-years after implementation of the program. From January to March 2011, samples were collected from irrigation water, potting media, used containers, and soil substrate at 13 GAIP nurseries. Irrigation water samples were collected from each nursery's water source. Potting media samples were collected from individual media components and from finished media. Potting media and debris were scraped from the insides of 25 used containers to create a composite used container sample per nursery. Transects were walked within each nursery, with inspectors collecting soil subsamples at three points located equidistant along each transect to create one composite soil substrate sample per transect. All samples were tested by baiting with healthy *Viburnum davidii* Franch. leaves followed by plating on PARP. A total of 354 samples were collected from all CCP checked in this study, with 30.2 percent testing *Phytophthora* positive. *Phytophthora* was detected in 10.3 percent, 30.4 percent, 36.4 percent, and 45.5 percent of potting media, used container, soil substrate, and irrigation water samples, respectively. *Phytophthora* incidence in irrigation water and soil substrate samples was significantly different from the incidence in potting media samples ( $p < 0.05$ ), although there was no significant difference between soil substrate and used container samples. When looking at the number of nurseries with *Phytophthora* detected at each CCP, soil substrate (92.3 percent of nurseries) and irrigation water (66.7 percent of nurseries) were significantly more likely to be sources of potential contamination than potting media (30.8 percent of nurseries) and used containers (33.3 percent of nurseries) ( $p < 0.05$ ).

*Key words:* Grower Assisted Inspection Program, *Phytophthora*, nurseries, critical control points

## Introduction

In 2007 and 2008, the Oregon Department of Agriculture implemented the Grower Assisted Inspection Program (GAIP) for nurseries. Participants in GAIP must adopt best management practices (BMP) for critical control points (CCP) where foliar *Phytophthora* species can be introduced into their nursery. These CCP were identified previously as used containers, irrigation water, soil substrate, potting media, and incoming plants (Parke et al. 2009). The goal of this study was to determine the presence or absence of *Phytophthora* at four of the CCP in GAIP nurseries 3- to 4-years after implementation of the program.

## Materials and Methods

Samples were collected from irrigation water, potting media, used containers, and soil substrate once at each nursery from January through March, 2011 (table 1). Irrigation water samples (3.7 L or 1 gal each) were collected from each water source and tested within 48 hours of collection. Potting media samples (1000 cm<sup>3</sup> or 1 qt each) were collected from individual media components and from finished media. Used container samples were collected by scraping potting media and debris from inside 25 used containers to create a composite sample of 1000 cm<sup>3</sup> (1 qt). Soil substrate samples were

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<sup>2</sup> Oregon Dept. of Agriculture, 635 Capitol St NE, Salem, OR 97301.

collected by walking transects within each nursery and collecting 350 cm<sup>3</sup> (0.37 qt) subsamples at three points located equidistant along each transect to make one composite sample per transect. The number of transects walked depended upon nursery size, ranging from six in nurseries <0.4 ha (1 ac) in size to 36 in nurseries 202 to 405 ha (500 to 1,000 ac) in size.

**Table 1—The number of samples collected from 13 nurseries at four critical control points for *Phytophthora* introduction into nursery production systems**

Nursery	Critical control points			
	Irrigation water	Used containers	Potting media	Soil substrate
86	0	1	3	13
36	8	0	2	39
53	5	1	5	32
77	5	0	6	13
10	1	1	1	6
38	2	0	1	6
88	2	1	1	8
9S	3	1	4	19
9G	3	2	4	24
9D	3	1	4	20
75	4	2	4	30
28	5	1	2	30
84	3	0	2	20

All samples were tested by baiting with healthy *Viburnum davidii* Franch leaves followed by plating on PARP (USDA APHIS PPQ 2010b, 2010c). Statistical analyses were performed using analysis of variance for a completely randomized design with unequal replication and by calculating the least significant difference between means.

Thirteen nurseries were surveyed. None adopted BMPs specifically for soil substrate, although practices adopted for other CCP could affect *Phytophthora* populations in soil. The nurseries ranged widely in size; three were ≤2 ha (5 ac), five were 4 to 40 ha (10 to 100 ac), four were 40 to 202 ha (100 to 500 ac), and one was >202 ha (>500 ac). Irrigation water sources varied by nursery, with three nurseries using well water only, two using well and river water, two using well and recycled water, two using river and recycled water, two using recycled water only, and two using water from all three sources.

Each nursery adopted BMPs for the four CCPs that worked best for their production system (table 2). For used containers, BMPs included using new containers on host and associated host plants for *Phytophthora ramorum* (USDA APHIS PPQ 2010a), steaming or chemically sanitizing pots, and recycling used pots. For potting media, BMPs included storing media on a concrete pad or other barrier, using dedicated or cleaned potting equipment, testing the media, using commercially-produced media, or steam sanitizing used media before re-use. For irrigation water, BMPs included using well water, using chemical or biological treatments, and testing the water quarterly for *P. ramorum*. Several nurseries used multiple BMPs for each CCP.

## Results and Discussion

A total of 354 samples were collected from all CCPs for this study, with 30.2 percent testing *Phytophthora* positive. *Phytophthora* was detected in 10.3 percent, 30.4 percent, 36.4 percent, and 45.5 percent of potting media, used container, soil substrate, and irrigation water samples, respectively. *Phytophthora* incidence in potting media was significantly lower, and in irrigation water was significantly higher, than *Phytophthora* incidence in used containers and soil substrate samples ( $p < 0.05$ ).

When looking at the number of nurseries with *Phytophthora* detected at each CCP, soil substrate and irrigation water were significantly more likely sources of potential contamination (fig. 1). Nine nurseries had no positive detections in their potting media samples.

**Table 2—Number of nurseries adopting specific best management practices (BMP) for four critical control points (CCP) for *Phytophthora* introduction into nursery production systems**

CCP	BMP	No. of nurseries adopting BMP
Irrigation water	1. Use well water	9
	2. Use chemically/biologically treated water	5
	3. Test water for <i>P. ramorum</i>	5
	4. Use multiple listed BMPs	10
Potting media	1. Store on concrete or other barrier	12
	2. Use cleaned/dedicated equipment	11
	3. Test for <i>Phytophthora</i> before use	6
	4. Steam before use	1
	5. Media from a commercial source	2
	6. Do not re-use potting media	1
	7. Use multiple listed BMPs	13
Used containers	1. Use new pots on HAP <sup>a</sup>	12
	2. Recycle used pots	3
	3. Steam/sanitize pots before re-use	8
	4. Used pots for non-HAP only	1
	5. Use multiple listed BMPs	11

<sup>a</sup> HAP = host and associated host plants for *P. ramorum*

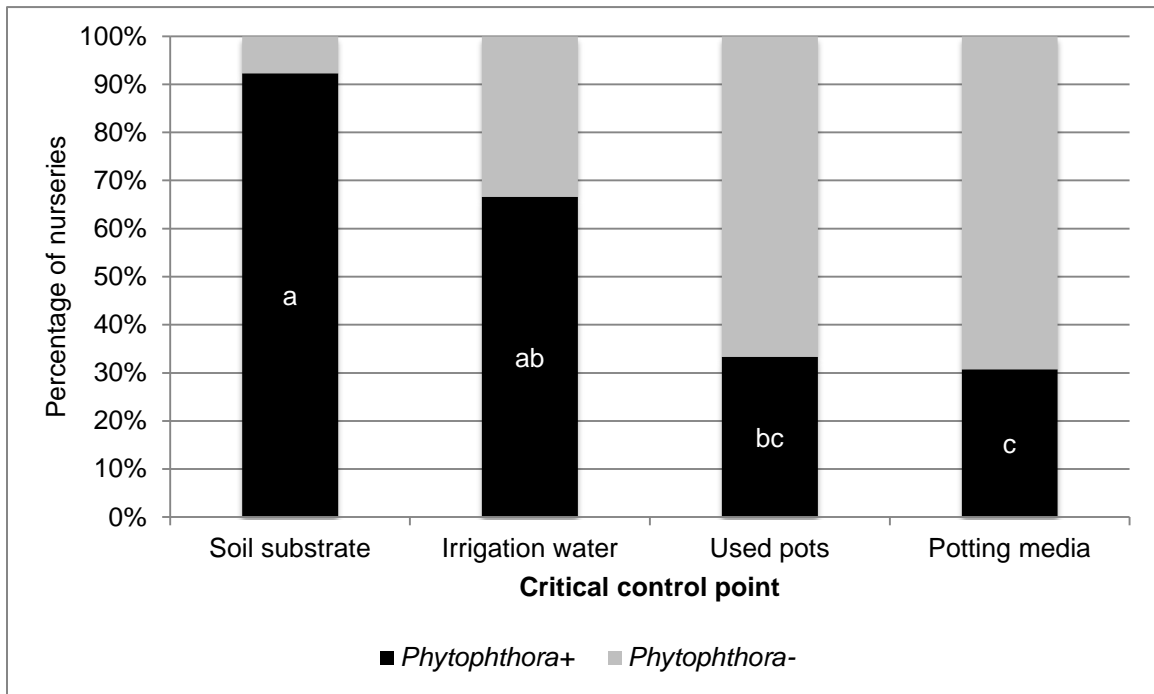


Figure 1—Percentage of nurseries with *Phytophthora* detected at four critical control points; statistical significance ( $p \leq 0.05$ ) is indicated by different letters.

Forty-four water samples were collected for testing, with *Phytophthora* detected in 20. When examined by water source, river water and water in recycling ponds were significantly more likely to have a *Phytophthora* detection (fig. 2).

Most samples collected for testing were from soil substrate. Two hundred sixty samples were collected, with 30.4 percent positive for *Phytophthora* (fig. 3). *Phytophthora* incidence was significantly different between the nurseries, with incidence tending to be higher in larger nurseries.

Eleven samples were collected from used containers, with four positive for *Phytophthora*. Of the positive samples, *Phytophthora* was detected once after the pots had reportedly been sterilized.

Thirty-nine samples were collected from potting media components and mixtures, with *Phytophthora* detected in four. One positive sample was collected from media stored on a bark layer. Two of eight samples collected from media stored on gravel were positive. One of 27 samples collected from media stored on a concrete pad tested positive. This latter sample was collected from a nursery that did not use cleaned or dedicated potting equipment.

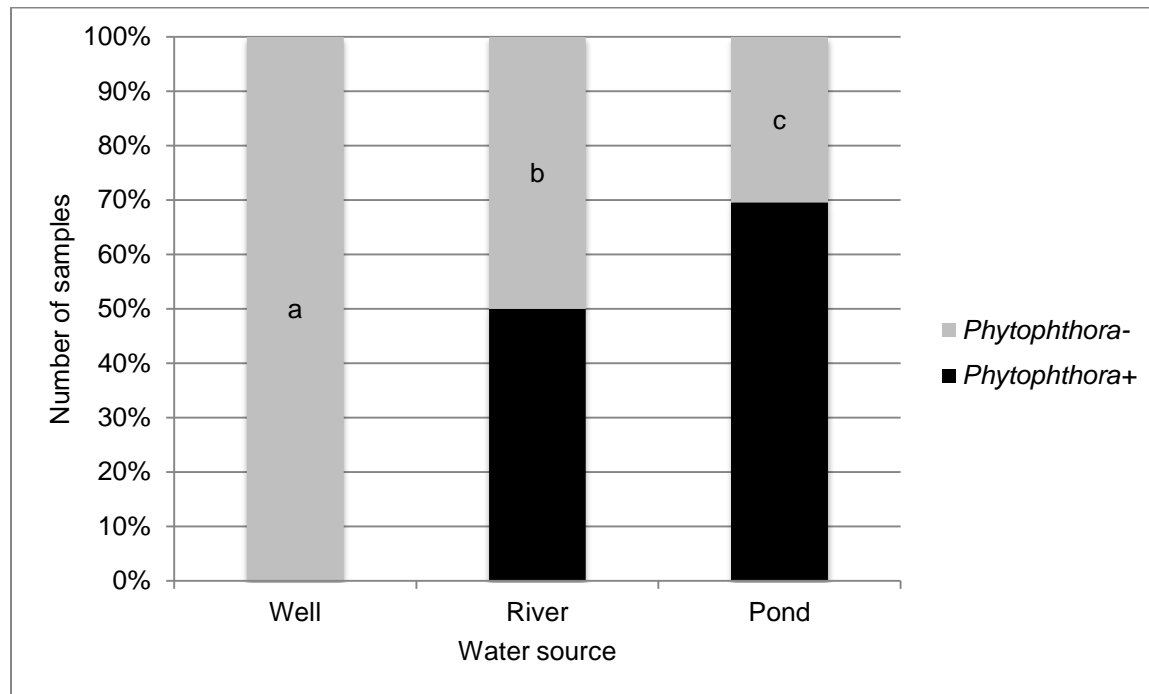


Figure 2—The number of samples testing positive for *Phytophthora* by water source; statistical significance ( $p \leq 0.05$ ) is indicated by different letters.

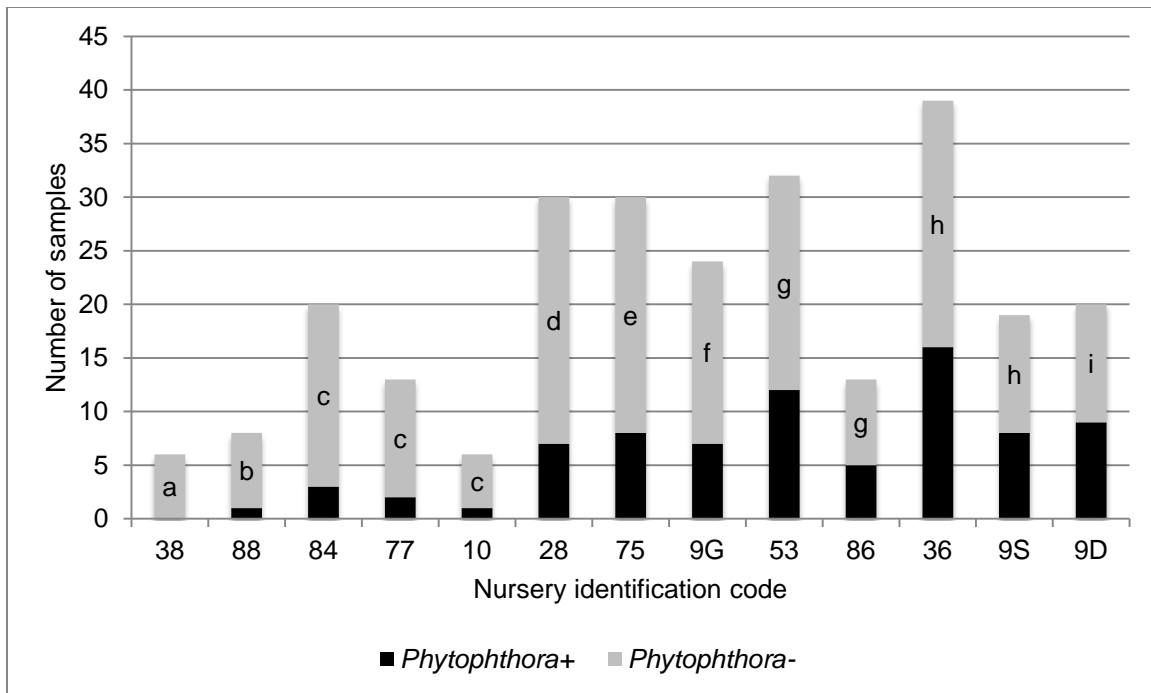


Figure 3—*Phytophthora* incidence in soil substrate samples collected and tested from each nursery; statistical significance ( $p \leq 0.05$ ) is indicated by different letters.

The results of this study underscore the importance of these CCPs as sources of *Phytophthora* contamination within nurseries. It also highlights BMPs that effectively mitigate the risk presented by each CCP and the importance of performing BMPs correctly or using multiple BMPs for a CCP to achieve maximum protection. Although all four CCPs 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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