Dynamics of soil borne pathogens and alternatives to fumigation in raspberry

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Abstract

The Pacific Northwest of the US encompasses 90% of processed raspberry acreage nationwide which generates an average of $35 million/year. The majority of this production (~90%) is in Skagit and Whatcom counties. The duration of harvestable plantings has declined from >10 to approximately 5 yrs. Root damage by *Phytophthora rubi* (Pr) and *Pratylenchus penetrans* (Pp) has been associated with this decline, but soil characteristics that promote these pathogens are not well understood. More information is needed on the biology and ecology of these pathogens in order to develop more suppressive soil systems. Currently, broadcast pre-plant fumigation is the main tool used to manage soil borne pathogens; a practice that is expensive and chemically intensive. A more holistic approach to root health management in raspberry is needed.

Assess pathogen affect on root health

Develop sensitive assay for detecting pathogens

Investigate alternatives to fumigation

What is a disease suppressive soil?

A suppressive soil is one in which "the pathogen does not establish or persist, establishes but causes little or no damage, or establishes and causes disease for a while but thereafter the disease is less important, although the pathogen might persist in the soil." (1)

Understand pathogen biology and ecology + Biocontrol Mechanisms: Antagonism, Competition, Exploitation, Resistance = Integrated soil management strategies

1. Baker, K.F. and R.J. Cook. 1974. Biological Control of Pathogens. Freeman, San Francisco.
2. Stone, A.G., Scheurell, S.J. and H.M. Darby. 2004, Suppression of soilborne diseases in field agricultural systems: Organic matter management, cover cropping and other cultural practices. In *Soil organic matter in sustainable agriculture*. Ed. Magdoff, F. and R.R Weil. CRC Press, New York.

Current Research

In a survey (fall 2008) of 10 red raspberry fields exhibiting symptoms of root rot in Skagit and Whatcom counties, both Pr and Pp were detected. Levels of Pp and frequency of Pr varied between sites (Table 1). Further work is aimed at relating soil properties to pathogen occurrence and greenhouse studies are underway to better understand the combined effect of both pathogens on root rot disease. More information on the biology and ecology of these pathogens will help to develop alternative management strategies.

Table 1. Results of fall 2008 Skagit and Whatcom county raspberry field soil borne pathogen survey.

Survey Field[1]	Variety	Plant Age (yrs)	P. penetrans per g root tissue[2]	% sites positive for Phytophthora spp.[3]	% sites positive for Phytophthora rubi[4]
1	Meeker	3	645	90	67
2	Meeker	6	2411	90	25
3	Meeker	4	1	90	100
4	Cascade Delight	4	696	60	67
5	Tulameen	4	432	30	67
6	Meeker	3	1614	100	100
7	Meeker	3	7643	40	67
8	Meeker	4	192	80	100
9	Meeker	4	10	80	100
10	Tulameen	5	478	40	33

[1] Fields were located in either Skagit (Fields 1-5) or Whatcom county (Fields 6-10) and were located with assistance from WSU Whatcom and Skagit county extension.
[2] Average value of ten sites per survey field.
[3] Positive for *Phytophthora* means the sample tested positive with ELISA. Average of ten sites per survey field.
[4] Positive for *P. rubi* means the sample tested positive in a PCR test (2). Samples were analyzed through Whatcom county *Phytophthora* Survey. Average value of 3 sites per survey field (4 sites, survey field 2).

Integrating Alternative Approaches- Solarization

An alternative to fumigation may be solarization. Field trials are underway at WSU-NWREC to test the efficacy of this management tool in this region. Pr can be controlled at temperatures over 29°C for extended periods of time (Figure 1). In northwestern WA, solarized soils can potentially reach 29°C for sustained periods of time, but results are variable by year.

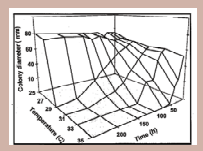

Figure 1. Growth of Pr colonies after exposure to 25-30 °C for 0-240 hours. (From Pinkerton et al. 2009)

Pinkerton et al. 2009. Solarization as a component of an integrated program for control of raspberry root rot. Plant Dis. 93:452-458.

CURRENT
- EPA restrictions to common fumigant
- Short-term efficacy

SHORT-TERM
- New chemicals/ combinations
- Semi-resistant varieties

LONG-TERM
- Novel pre-plant strategies
- Diversified Rotations
- Middle-row management

OUTCOMES
- Improved soil quality
- Less reliance on inputs
- Comparable yields