Soilborne Pathogen and Nematode Management through Removal of Root Inoculum in Continuous Red Raspberry Systems

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Background and Rationale

- Red raspberry (*Rubus idaeus*) is a major crop in the Pacific Northwest (PNW) of the US with 10,800 acres harvested in 2014 and an estimated production value of $66.8 million (NASS, 2015).

Figure 1. 'Tulameen' raspberry infected by *P. rubi*.

- Two of the known soilborne microorganisms affecting raspberry production in this region are the oomycete, *Phytophthora rubi* (casual agent of **Phytophthora root rot; Fig. 1**) and the plant-parasitic nematode, *Pratylenchus penetrans* (otherwise known as **root lesion nematode**).
- The industry relies heavily on soil fumigation for management of soilborne pathogens and pests, with growers typically fumigating fields in the fall or spring prior to replanting in continuous systems.
- Large amounts of root and crown material remain in fields prior to renovation, which could serve as a source of inoculum and bridge for soilborne pathogens and pests (**Fig. 2**).

Figure 2 . 'Meeker' raspberry field in the process of renovation. In most systems, residual root and crown materials in the field are incorporated into the soil prior to fall fumigation and replanting in spring.

This project explores the horticultural technique of raspberry root and crown removal as a pre-plant tool for the improved and integrated management of disease-causing organisms.

Objectives and Hypothesis

- The primary **objective** of this project is to demonstrate and evaluate the efficacy of raspberry root inoculum removal as a pre-plant management technique for reducing soilborne pathogen and pest populations.
- The long-term **objective** of our work is to develop tools for the integrated management of soilborne pathogens and pests, including alternatives to soil fumigation.
- Our **hypothesis** is that root inoculum removal will reduce populations of soilborne pathogens and pests, thereby enhancing the utility of other management techniques.

Materials and Methods

Experiment 1.

- Three root removal devices were compared for speed and efficacy of root removal in commercial fields. Devices tested includes: Lundby plant lifter, beach cleaner, and potato harvester (**Fig. 3**).

Experiment 2.

- To evaluate the effects of root removal on soilborne pathogens and pests, a split-split plot experiment was established in a commercial field of 'Meeker' red raspberry in Aug. 2014 in Whatcom County, WA.
- The main plot factor was fumigation (with or without, using Telone ® C-35) and the split plot factor was root removal (with or without removal using a Lundby plant lifter), replicated six times. Main plots were 30.5 x 9 m and the split plots 15 x 9 m in size.
- Data to be collected includes: changes in soilborne disease (*Fusarium* and *Pythium*, proxies for *P. rubi*) and *P. penetrans* populations, plant growth, and yield. This experiment will continue until 2018.

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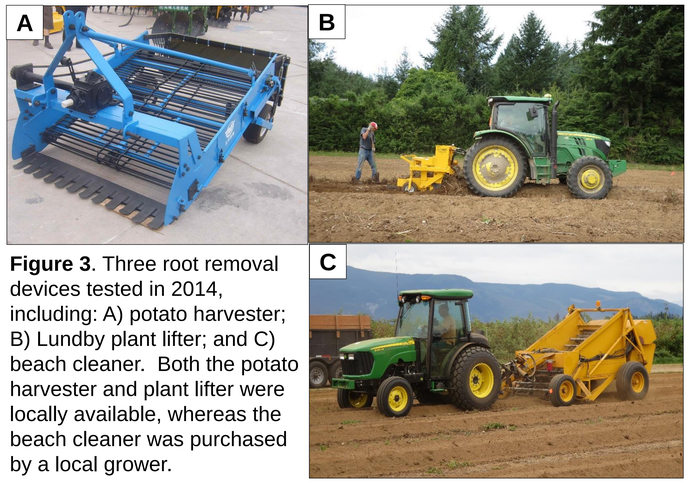

Figure 3. Three root removal devices tested in 2014, including: A) potato harvester; B) Lundby plant lifter; and C) beach cleaner. Both the potato harvester and plant lifter were locally available, whereas the beach cleaner was purchased by a local grower.

Preliminary Results

Experiment 1.

- All three devices removed 98% of the root/crown material (**Fig. 4**). The average speed of the plant lifter, beach cleaner, and potato harvester were 0.4 km/hr, 0.6 km/hr, and 1.6 km/hr, respectively.

Experiment 2.

- Root removal reduced population densities of *P. penetrans* by 99.8% in plots that received the root removal treatment.
- *Fusarium* and *Pythium* populations were reduced through root removal (16 and 21%, respectively), but fumigation had a greater effect at reducing their numbers (41 and 64%, respectively). The combined effect of root removal with fumigation was the most effective and reduced *Fusarium* and *Pythium* by 64 and 69%, respectively.
- Large roots remaining in control plots were colonized by both pathogens regardless of fumigation treatment, indicating that these roots serve as residual sources of inoculum.
- Initial results suggests root removal may be a useful tool for managing soilborne pathogens and pests.

Figure 4. Volume of roots remaining before (A) and after (B) root removal in a 0.1 m³ excavated plot.

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