Combatting Plant-Parasitic Nematodes in the Pacific Northwest

Inga Zasada, Amy Peetz, Megan Kitner, Hannah Baker, Gabrielle Studebaker, Tatiana Benedetti, Cristian Olaya, Lester Núñez-Rodríguez, Savannah Phipps, Brandon Fahlenkamp, McKenna Platt

Improving resistance for sustainable root lesion nematode (*Pratylenchus penetrans*) management in Pacific Northwest red raspberry production

Savannah Phipps is the PhD student on the project

The root lesion nematode, *Pratylenchus penetrans*, is a significant production limiting pathogen in red raspberry (*Rubus idaeus*) production in the Pacific Northwest which has been routinely managed with soil fumigation for several decades. However, changes in regulations have resulted in fewer fumigant options and greater regulations. Growing tolerant or resistant cultivars can serve as a sustainable method for controlling root lesion nematode, however little is understood about the nature of root lesion nematode resistance or tolerance in red raspberry. A collaborative effort between the USDA-ARS/Oregon State University, Washington State University, British Columbia Berry Cultivar Development Inc. breeding programs, and the National Clonal Germplasm Repository aims to better characterize this resistance through a genome wide association study on a diverse panel of 270 red raspberry genotypes and evaluate methods to improve the selection time of desirable genotypes using genomic prediction and high throughput phenotyping technologies.

Development of baseline information of plant-parasitic nematodes in hops in the Pacific Northwest

PPNs in Pacific Northwest (PNW) hops production, which accounts for 98% of total hop planted area in the US, are poorly understood. Only two research efforts have been published about PPNs in hop in the PNW in the last 30 years. This research effort is a collaboration between Oregon State University, USDA-ARS-Corvallis, OR, USDA-ARS-Prosser, WA, and Hop Research Council.

Lester Núñez is the PhD student on the project

Results from this research will include an up-to-date assessment of common PPNs in PNW hop fields, the host status of widely planted hop varieties for PPNs, and a population genetics assessment of *H. humuli* populations from around the world. This information can be leveraged to understand the potential for PPNs to cause damage to hops and to inform the development of management strategies.

Characterizing root-knot nematode (*Meloidogyne hapla and M. chitwoodi*) in potato and development of quantitative PCR assay for *M. hapla* in the Pacific Northwest

Gabrielle Studebaker is the MS student on the project

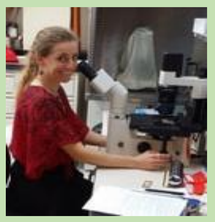
The root-knot nematodes, *Meloidogyne hapla* and *Meloidogyne chitwoodi*, results in significant damage to potato tubers making them unmarketable. Given the low tolerance in the industry, researchers at the USDA-ARS and Oregon State University are conducting research to better understand the interaction between nematode infestation and tuber size and quality. A field trial including three of the top russet potatoes, Ranger Russet, Russet Burbank, and Clearwater, is underway to compare varying densities of *M. hapla* and *M. chitwoodi* infestation and their overall impacts on tubers. Additionally, quantitative PCR can be a useful tool for nematode diagnostics and work is underway to develop a qPCR primer/probe for *M. hapla* detection. Soil sampling throughout Oregon and Washington combined with qPCR diagnostics will contribute to an updated view of *M. hapla* presence and distribution across the Pacific Northwest region.

Our nematology research program focuses on the development of management strategies for plant-parasitic nematodes affecting high value horticultural crops. The overall goal of our research is to identify sustainable nematode management practices that are economically viable and environmentally friendly while remaining effective.

Current projects include the evaluation of grape rootstocks for root-knot nematode management, integrated management of root lesion nematode in raspberry, and genomic insights into plant-parasitic nematodes including the nematode microbiome.

Dr. Inga Zasada
Primary Investigator

Amy Peetz
Lab Technician



Megan Kitner
Lab Technician

Pulse electricity: a non-chemical approach for the management of nematodes, pathogens, and weeds in nurseries

Soilborne pathogens, diseases, and weeds are major constraints to the production of tree seedlings for the ornamental industry. Failure to control pathogens can result in seedling death or the unintentional distribution of nursery stock infected with pathogens. Failure to control weeds can lead to competition with seedlings for water and nutrients. Because soilborne diseases and weeds are increasingly difficult and expensive to manage, the nursery industry has requested non-chemical alternatives for the existing practices.
The objective of this research is to discover new ways to manage soilborne pathogens and weeds that reduce reliance on pesticides and soil fumigants.

Dr. Tatiana Benedetti
Postdoctoral Researcher

In collaboration with LisiGlobal, Inc. (Richland, WA), controlled experiments have been conducted using a directed energy system (DES) to evaluate the application of energy pulses to the soil to suppress nematodes, pathogens, and weed seeds.

Strategies for detection of ringspot viruses in dagger nematodes in small fruits and grapevines

Dr. Cristian Olaya
ORISE Postdoctoral Researcher

The $840 million small fruit industry in the PNW faces several phytosanitary risk scenarios, one of these is the emergent or re-emergent viruses transmitted by nematodes (nepoviruses). These viruses cause a negative effect as they induce yield and quality reduction as well as loss of vigor in small fruits and grapes. Early stages of the infection can remain hidden without obvious symptoms, but when they become evident, it may have already spread in the orchard or the vineyard. This is especially problematic in perennial crops when the virus is vectored by nematodes (*Xiphinema spp.)*, due to long-term and challenging management practices.

McKenna Platt
Undergraduate Research Assistant

This research is focused on the development of detection methods for nepoviruses in their nematodes vector, both found in small fruit orchards and vineyards in the Pacific Northwest. For this we are:

- Surveying small fruits and wine grapes in the Pacific Northwest for Dagger nematode and nepoviruses
- Understanding the diversity of tomato ringspot virus (ToRSV) and developing RT-qPCR detection methods
- Developing in-house growth chamber cultures of dagger nematode harboring the virus
- Understanding the infection of ToRSV in cucumber bait plants

Putting Litchi Tomato (*Solanum sisymbriifolium*) to the Root-Knot Nematode Test

Root-knot nematodes (RKN) are a major pest and are primarily controlled using nematicides which have adverse effects on human and environmental health. This research is focused on the RKN *Meloidogyne hapla*, in potato, vegetables, and wine grape, and *M. chitwoodi* in potato production. A proposed management strategy for these nematodes is a wild solanum species known as litchi tomato, *Solanum sisymbriifolium*, which has been found to suppress RKN.

Incorporation assays utilizing aboveground and belowground materials have demonstrated varying impacts to the infection capabilities of *M. hapla* into tomato roots. This method has been employed in greenhouse assays, comparing incorporation of various quantities of freeze-dried plant material, and in microplot assays, comparing incorporation of recently harvested plant material to fallow and potato.

Additionally, evaluation of extracts from litchi tomato plant material on the hatch of *M. hapla* and subsequent infection of tomato have been performed but data is still being collected before a determination on the level of impact can be made.

Hannah Baker
Lab Technician

Brandon Fahlenkamp
Undergraduate Research Assistant