Final Plain Language Research Summary - AgriScience Grape & Wine Cluster 2018-2023

Activity: *Unearthing the impacts of plant-parasitic nematodes on grapevine health and productivity*

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Introduction

Plant-parasitic nematodes (PPNs) are important components of vineyard soil ecosystems, with several species of root-knot (Meloidogyne sp.), root-lesion (Pratylenchus sp.), dagger (Xiphinema sp.) and ring (Mesocriconema sp.) nematodes known to be significant pests of grape vines grown in most major grape-growing regions of the world. The impacts of PPNs on grapevine health in the Okanagan and other cool climate growing regions in Canada are less well known. Vineyards generally harbour multiple species of PPNs and research to assess the interaction of multi-species PPN assemblages with other biotic and abiotic stresses under field conditions would greatly improve current understanding of the overall impacts of PPNs on grapevine health and vineyard productivity. More specifically, better knowledge of the distributions of PPN species among vineyards would improve understanding of the overall importance of PPNs to vineyard health in Canada; improved knowledge of PPN spatial distributions within vineyard blocks would facilitate the development of improved sampling strategies for diagnostic purposes. As well, analysis of factors governing spatial variation in PPN populations would enhance fundamental understanding of factors driving spatial variation in broader soil biological processes, and the influences of agricultural practices on those populations and processes.

Objectives of the proposed research:

1. Determine the distribution of key species of plant-parasitic nematodes (PPNs) in relation to soil health indicators in representative Okanagan vineyards
2. Assess spatial co-variation of PPN populations with vine water stress and the incidence of trunk and crown gall disease.
3. Use controlled-inoculation of field micro-plots to experimentally determine effects of key PPN species on vine growth and incidence and expression of disease complexes.
4. Determine the presence and abundance of key PPN species in representative vineyards in Nova Scotia.

Methodology and Results:

Objective 1 - distribution of key species of plant-parasitic nematodes (PPNs) in relation to soil health indicators in representative Okanagan vineyards.

There was no significant activity on this objective in 2022 as it was completed in 2021.

Deliverable Publication: Forge, T., Munro, P., Midwood, A.J., Philips, L., Hannam, K., Neilsen, D., Powers, T., and Zasada, I. 2021. Shifting prevalence of plant-parasitic nematodes in orchards and vineyards of the Okanagan Valley, British Columbia. Plant Health Progress. Published Online: 24 Mar 2021, https://doi.org/10.1094/PHP-10-20-0079-RS.

Objective 2 - spatial co-variation of PPN populations with vine water stress, vine decline symptoms in virus-infected and virus-free grapevines, and the incidence of trunk and crown gall diseases.

The approach and methodology for this objective involved analyzing population densities of plant-parasitic nematodes in key field experiments being managed by CGCN-funded collaborators as follows:

Relationships with irrigation scheduling and vine water relations:
This field experiment was established by AAFC collaborators Pat Bowen & Carl Bogdanoff at SuRDC in 2018. The initial objective was to determine effects of alternative irrigation scheduling protocols on ring nematode (Mesocriconema xenoplax) population densities, vine growth parameters, and relationships between nematode population densities and vine growth parameters. Sampling and analyses of nematode populations in all 60 plots was initiated in spring of 2018, and was repeated in May and October of each year thereafter. However, the irrigation treatments and vine water relations ceased in 2020 due to Covid-19, and the two collaborators retired in 2021. Nonetheless, analyses of nematode populations in all plots carried on from 2018 through 2022. As the irrigation treatments ceased in 2020, statistical analyses are proceeding to relate plot-to-plot variation in nematode population densities to plot-to-plot variation in indicators of vine vigour.

Statistical analyses to date indicate a positive relationship between ring nematode population densities averaged over the entire study period and vine trunk cross-sectional areas. The maximum and range of population densities observed at the site are not very high relative to population densities observed in some vineyards (e.g. Forge et al. 2021).

Relationships with compost amendments and incidence of crown gall:
Two separate field experiments were established by UBC-Okanagan collaborators Tanja Voegel and Louise Nelson, with Ph.D. student Portiaa McGonigal, at Westpoint vineyard in southeast Kelowna. The objective of both experiments was to determine if surface application of composts to vine rows affects population dynamics of plant-parasitic nematodes, and through collaboration to analyze relationships between nematode population densities and incidence of crown gall, vine growth and fruit quality parameters. The first experiment was initiated in spring of 2019 using a randomized complete block design with three different compost treatments and a non-treated control applied to plots within in each of six replicate blocks. The three compost treatments were: GlenGrow municipal compost from the City of Kelowna (GG), Superior Peat's Weston blend compost (SP), and winery waste compost (WW) produced by the collaborating winery. All composts were surface-applied to the vine row at a bulk rate estimated to provide the same amount of organic matter: 6.12 Mg organic matter/ha vineyard. The second experiment was initiated in a different part of the same vineyard in spring of 2020, and involved application of GG and SP composts in comparison to mounding of soil and non-treated control plots. Composite soil samples were taken from each plot for nematode analyses at the time of project initiation and in spring and fall of each year thereafter. Sampling procedures and methods for nematode analyses were the same as those used routinely in the PI's lab and described in previous publications (e.g. Forge et al. 2019).

Detailed methodology and results information from this section is being withheld to avoid potential conflicts or difficulties during future manuscript publication.

Objective 3 - controlled-inoculation of field micro-plots to experimentally determine effects of key PPN species and mixtures on incidence and expression of disease complexes.

Root-lesion nematodes:

While root-lesion nematodes (Pratylenchus species) are widespread in BC vineyards, greenhouse experiments conducted in previous years indicated that Pratylenchus penetrans, the most common species on most other cool-temperate horticultural crops such as apple and cherry, is not able to parasitize V. vinifera grapevines. In 2022, work to identify the species from BC vineyards indicated that most vineyards have P. neglectus rather than P. penetrans. New cultures of P. neglectus from vineyards, for use in future experiments, have been established at SuRDC.

Ring nematodes:

The nematology lab is collaborating with the grape pathology program (Dr. Urbez-Torres, Ph.D. student Jared Hrycan) via contributing to greenhouse experiments and a field microplot experiment to test the influence of ring nematodes on expression of trunk diseases. The greenhouse experiments were conducted in previous years. The field microplot experiment was inoculated and planted in early 2021. Winter injury incurred during the winter of 2021-22 was rated after bud break in early June of 2022. Chi-square analyses indicated that a greater proportion of nematode-inoculated vines (44%) died over winter than non-inoculated vines (19%).

Objective 4 - presence and abundance of key PPN species in representative vineyards in Nova Scotia.

There was no activity associated with this objective in 2022 as work on it was completed in 2021.

Deliverable publication: Forge, T., Munro, P., Wright, H. & Moreau, D. 2022. Plant-parasitic nematodes in Nova Scotia vineyards. Phytoprotection, 102(1), 15–20. https://doi.org/10.7202/1088485ar.