BC FoodWeb

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RESEARCH SUMMARY

Fighting grapevine root diseases with brassica cover crops

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Production Type
- Wine grapes

Practice Benefit(s)
- Pest management
- Improved soil health

Research Location
- Kelowna, BC

KEY TAKEAWAYS

- **Brassica cover crops** can provide benefits in vineyards **without** being incorporated with tillage.
- **Shepherd's purse and white mustard** showed potential for **controlling the parasitic nematode population**, lowering the odds of finding a parasitic nematode by 46% and 52%, respectively.
- **Shepherd's purse and rockcress**, two naturally-occurring plants in BC vineyards, are **viable cover crop options** that have the potential to improve soil health.

Key Terms:
- *Brassica: a group of plant species in the mustard plant family that includes cruciferous vegetables.*
- *Nematodes: a group of tiny, microscopic worm species that live in the soil. They can be free-living (harmless), plant parasites, or predators that play an important role in controlling plant pests and disease.*

Figure 1. Study site at Tantalus Vineyards. Photo by Corynne O'Farrell.

HOW CAN THIS RESEARCH BE USED?

- Grape growers in British Columbia (BC) can use **white mustard, tillage radish, shepherd's purse, and/or rockcress** as cover crops in their vineyards. The cover crops can be left intact throughout the growing season and do not need to be incorporated with tillage.

WHY WAS THIS RESEARCH DONE?

This study explored the potential of four brassica cover crops to control soil borne pathogens in vineyards.

RESEARCH SUMMARY

Vineyards can suffer significant economic loss due to crop destruction from soil-borne root diseases. This includes fungal trunk diseases found commonly in the Okanagan such as black-foot disease and Petri disease. Parasitic nematodes, such as root-knot and ring nematode, also cause damage to grapevine roots and lead to reduced yield, stunted growth, and/or eventual death of the grapevine.

One way of controlling fungal diseases and parasitic nematodes is the use of cover crops. Some species of cover crops, particularly in the Brassicaceae family, produce chemicals that suppress the growth of bacteria, fungi, nematodes, weeds, and insect pests. Because the chemicals are primarily released when plant tissues are broken down, cover crops are typically mixed into the soil with tillage. However, in perennial systems like vineyards, tillage can only occur in the interrow to avoid disturbing the grapevine roots. This leaves the soil closest to the grapevines un-protected from pathogens. Additionally, intensive tillage has been found to have negative impacts on soil health.

WHAT WAS THE OUTCOME?

After only one growing season, brassica cover crops had impacts on the soil fungal and nematode communities.

The cover crops did not significantly affect the total number of nematodes found in the soil. The number of nematodes ranged from 780 nematodes per 100 mL soil to 1932 nematodes per 100 mL soil, with an average of 1542 nematodes per 100 mL soil. Plots with shepherd's purse and white mustard cover crops had a lower ratio of parasitic nematodes to beneficial nematodes, compared to the plots with no cover crops (control plots) (Figure 3). In comparison to the control plots, shepherd's purse lowered the odds of finding a parasitic nematode by 46% while white mustard lowered the odds by 52%. This is likely because the nematodes in this field were particularly sensitive to the combination of chemicals released by shepherd's purse and white mustard.

Figure 2. The cover crops used in this study. From left to right: rockcress, shepherd's purse, tillage radish, and white mustard. Photos by Corynne O'Farrell.

The cover crops did not affect the total number of fungi species in the soil, and did not adversely affect the abundance of beneficial fungi living in/near roots (arbuscular mycorrhizal fungi). The use of rockcress as a cover crop led to higher fungi species evenness compared to control plots (Figure 4). This means that the number of individual organisms is more equal between each species. Higher species evenness typically means that the ecosystem is healthier as there is less dominance by a single, or a handful of, species.

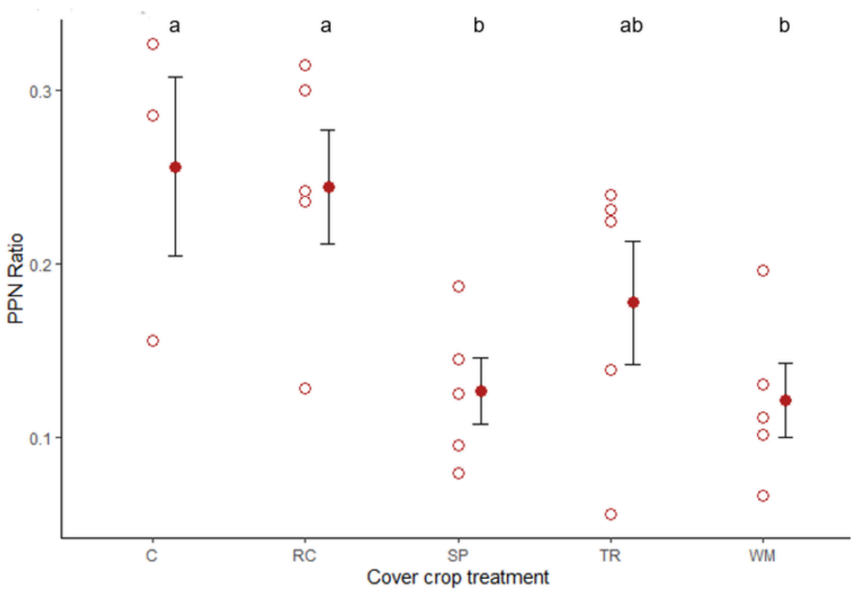

Figure 3. Effect of cover crops on the ratio of parasitic to free-living nematodes (PPN ratio) in the soil. A higher value indicates more parasitic nematodes. C = undisturbed control; RC = rockcress; SP = shepherd's purse; TR = tillage radish; WM = white mustard. Solid red dots are the average value. Crops that share the same letter (a or b) are not significantly different.

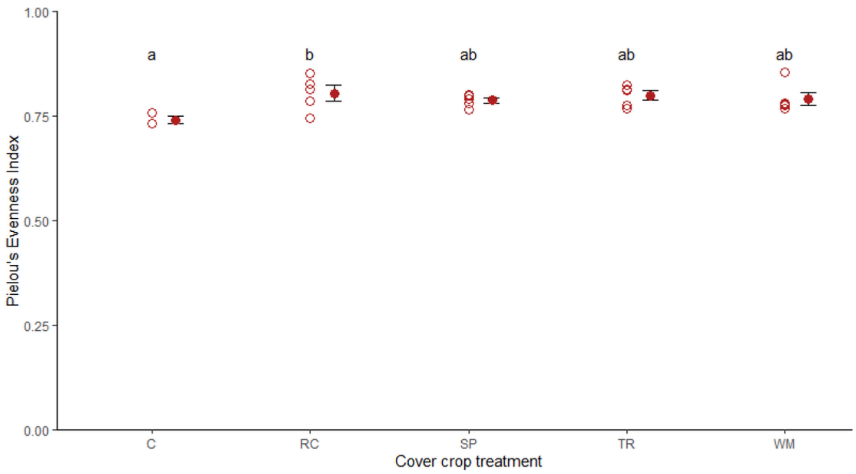

Figure 4. Effect of cover crops on soil fungi species evenness. A higher value indicates higher evenness. C = undisturbed control; RC = rockcress; SP = shepherd's purse; TR = tillage radish; WM = white mustard. Solid red dots are the average value. Crops that share the same letter (a or b) are not significantly different.

WHAT'S NEXT?

Our findings support the use of white mustard, tillage radish, shepherd's purse, and/or rockcress as cover crops in a no-till, vineyard setting. While white mustard and tillage radish are already commonly used in vineyards, they are often incorporated into the soil with tillage. Shepherd's purse and rockcress, on the other hand, are naturally occurring plants in the region, but aren't often used as cover crops. We did not find any negative effects of the four brassicas on the soil microbial community. Shepherd's purse, white mustard, and rockcress even demonstrated some positive effects after only one growing season.

Future research should test the ability of cover crops to reduce disease incidence by intentionally introducing pathogens, and examine functional changes in the soil community, such as nutrient recycling and plant-microbe interactions, that are not reflected in our community analysis.

HOW WAS THE RESEARCH DONE?

This study took place at Tantalus Vineyards, Kelowna, British Columbia from May to September 2020. The field used for the study was used as a horse pasture until 2012 and was fallow from 2012 to 2020. In May, we prepared the field by removing all vegetation in the rows except in the control plots which were left untouched. The interrows contained cover crops previously planted by Tantalus Vineyards, which we left undisturbed.

We chose two cultivars that are exotic to the region but commonly used as cover crops (white mustard and tillage radish) and two brassicas that are native or naturalized to the region (shepherd's purse and rockcress). Each of the four cover crops and the control were replicated five times, for a total of 25 plots. White mustard and tillage radish seeds were planted individually 2-3 cm in the soil, while shepherd's purse and rockcress seeds were sprinkled onto the soil.

The following seeding rates were used:

- Rockcress: 1 g/m^2
- Shepherd's purse: 1 g/m^2
- Tillage radish: 0.7 g/m^2
- White mustard: 1.1 g/m^2

Figure 6. White mustard plot near the end of the growing season. Photo by Corynne O'Farrell.

Two weeks after cover crop seeding, we planted five grapevines per plot. Plants were watered and fertilized as per vineyard management protocols (4.5 metric tonnes/acre of compost (Glengrow) in spring, no additional fertilizer). Vines and cover crops in the rows were irrigated by drip irrigation every other day for two hours at 1.89 L/h. Interrow vegetation was irrigated by microsprinklers for four hours every two weeks. Water came on in May and continued through the season. The plots were hand weeded as needed to ensure that the cover crops were the dominant species.

We took three soil samples from each plot and mixed it in a plastic bag. A subsample of the soil was stored in a paper bag, dried, and assessed for fungi species diversity, soil chemistry, and mycorrhizal fungi spores. We extracted the fungi DNA from the dried soil and sent it to the Centre for Comparative Genomics and Evolutionary Bioinformatics to determine the species in the soil and their abundance.

The remaining wet soil was used for assessing nematodes. Using a microscope, we counted the number of parasitic and free-living nematodes in each soil sample. Parasitic nematodes were distinguished by the presence of a needle-like mouthpart, while all other nematodes were considered free-living.

ABOUT THIS BRIEF

This brief is based on the following scientific journal article:
O'Farrell, C., Forge, T, & Hart, M. M. (2023). Using brassica cover crops as living mulch in a vineyard, changes over one growing season. International Journal of Plant Biology, 14(4), 1105-1116. https://doi.org/10.3390/ijpb14040081

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