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

Activity: *Spatial characterization of terroir and other vineyard attributes using GIS and imaging tools to guide precision management for water and nitrogen and to detect infections by virus and other pathogens*

Principal Investigator(s): Pat Bowen (AAFC Summerland)

GIS update and soil carbon survey:
The green house gas (GHG) emission due to human activities is one of the major drivers causing climate change. The GHG emission in agricultural sector is not fully understood. In the Interior BC, while the precipitation is the limiting factor of grape production, the viticultural production in BC relies on irrigation. The irrigated water can increase overall carbon fixation in this semi-arid environment. Thus, the viticultural practices in the Okanagan valley might contribute to GHG reduction. This study aims to find the correlations between soil carbon and all other vineyard characteristics we had collected in the GIS vineyard database. In this study, we analyzed the soils sampled from vineyards and natural (native) sites throughout the Okanagan Valley. Analyses included total and microbe-available carbon, cation exchange capacity, and plant nutrients. We analyzed additional 70 samples in 2022. The main findings from samples analyzed to date were: zero-tillage viticulture practices, common in BC, are not depleting soil C; and there is a strong relationship between soil C and soil texture regardless of vineyard management practices. These findings reveal the importance of considering soil texture in setting soil C sequestration targets for vineyards. A new map layer of potential carbon storage capability in a vineyard could be generated.

Interactive effects of seasonally timed water stress and cluster exposure:
This study evaluated the effects of water stress and cluster exposure on fruit composition in a Merlot vineyard. A two-way randomized complete block design experiment was conducted in a commercial vineyard in 2019 and 2021. Severe water stress was applied from fruit set to veraison or to harvest. The other milder water stress was applied all season as the control. In this nearly North-South oriented vineyard, high fruit exposure treatment was achieved by removing leaves at the east (80% leaf removal) and the west (50% leaf removal) side of the fruiting zone. The low fruit exposure treatment removed only 20% of the leaves on the east side. The results showed the irrigation treatment didn't affect cluster exposure. Leaf removal effectively exposed more clusters. The variations of juice Brix, pH and TA can be observed in berry samples taken from the surface of the clusters. This suggested light exposure, as a result of leaf removal, berry location in a cluster, or cluster location in a canopy, can affect juice composition. However, at harvest, no significant differences were observed among irrigation and cluster exposure treatments in yield, clusters per vine, cluster weight, berries per cluster, berry weight, juice Brix, juice pH, and TA. The study suggested direct sunlight exposure might change juice compositions of those exposed berries in the cluster. However, there might be limited effects of irrigation and fruit exposure practices on juice compositions at whole vine level.

Drone based imaging to guide precision management of irrigation and nitrogen:
Drone flight missions were performed in 2022 growing season for the irrigation trial conjugated with Activity 6. The preliminary results showed infrared (IR) thermal images have strong correlation with gas exchange activities of grape vines. The IR images capture the higher operational temperature of leaves when there is limited or no stomata opening. The reduced stomata conductance and transpiration means lower latent heat flux flowing out of the canopy. This experiment demonstrated the potential of using UAV-based platform for fast water stress detection in a large area. This technology might help irrigators to identify failed irrigation devices or help vineyard managers to determine irrigation timing. In the latter case, a well-irrigated plot might be the reference for detecting water stress in a commercial operation. Flight missions were performed in 2022 for the nitrogen trial conjugated with Dr. Kevin Usher's activity. The hyperspectrum and IR images had been processed. Detailed nitrogen concentration information will be available soon for regression analysis.

Drone and ground-based imaging to diagnose grapevine diseases:
Drone flight missions were conducted in the 2022 growing season. The processing of images is still in progress due to the large mass of data for point cloud analysis.