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

Activity: *Evaluation of Grapevine Viruses*

Principal Investigator(s): Debra Moreau (AAFC Kentville)

Part I: Impact of key economic grapevine viruses on vine performance and fruit quality
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To evaluate the impact of grapevine leafroll associated virus (GLRaV-3) and grapevine red blotch virus (GRBV) on vine performance and fruit quality, research focused on (a) establishing virus status in selected vineyard blocks, (b) monitoring vine performance parameters of individual GLRaV infected and non-infected vines, (c) evaluating fruit and wine attributes from vines observed in vine performance assessments, and (d) survey virus-confirmed blocks for incidence of insect vectors. A survey of 40 varietal blocks was conducted to establish the status of grapevine viruses in key varieties currently grown in Nova Scotia (NS). Plans to index an additional 10 varietal blocks in 2020 were not possible due to pandemic restrictions that prevented timely access to third party sites and labs for petiole processing. In collaboration with AAFC-SuRDC, CCOVI, and CFIA researchers, AAFC-KRDC efforts also included contributing to NGS screening of existing NS samples and dormant canes collected in 2022 and 2023.
Of the viruses detected, Grapevine Leafroll associated Virus-3 (GLRaV-3) is the most prevalent, followed by Grapevine Pinot Gris Virus (GPGV), Grapevine Red Blotch Virus (GRBV), Grapevine Leafroll associated Virus-1, then Grapevine Fanleaf Virus. Soil samples were also taken from the same varietal blocks surveyed for virus, to establish the composition of plant parasitic nematodes throughout the wine-grape regions in NS. Lesion, ring, dagger, root knot and pin nematodes were found. In general, nematode numbers may be impacting some NS vineyard blocks but not at serious levels. In most cases, counts were low and remain at levels that do not warrant concern.

Under pandemic restrictions, as an alternative to accessing commercial vineyards, a trial was setup in the research vineyard located at the Kentville Research and Development Centre (KRDC) in late May 2020 to compare both, previously confirmed, GLRaV-3 and GRBV infected plants. Plants infected with GLRaV-3 were compared to non-infected controls in 'Vidal' and 'New York Muscat (NYM)' while the same was done for GRBV in 'Marquette'. Over the remaining 3 years of the study, all vines-of-interest were inspected weekly to bi-weekly, photographed, and any observed symptoms recorded. The phenology and physiology (chlorophyll levels, carbon fixation rates, yield, fruit quality and dormant pruning weights) were assessed in both non-infected and infected vines across a number of time points. Grape samples from virus infected and non-infected vines were collected to evaluate the effects of

virus infection on grape chemical composition. Must from the grapes was analyzed for sugar, acid and volatile composition, and phenolics assessment. While treatment differences related to virus status were found, the impact on vine performance was nuanced and depended on the year of measurement and cultivar. For cultivars, °Brix values were typically lower in virus-infected vines, but variability was high between vines and this fell short of being significant. Additionally, virus vines showed signs of having lower leaf chlorophyll, but significant differences depended on the cultivar and year. Vidal Blanc and Marquette virus vines had higher fruit acidity levels in 2021. This negative trait has also been associated with better studied virus-infected vinifera cultivars. Unfortunately, there was no NYM fruit and the Vidal Blanc crop load was impacted significantly by the 2022 January freeze event. There was no difference in TA or Brix in the Vidal Blanc as a result of virus status. Similarly, there was no difference in Marquette TA; however, the Brix was weakly significant. Infected (GRBV) Marquette Brix was 24.4 while uninfected vines were 25.8 ($p = 0.0542$). This was the first time we saw a statistical difference in Brix in this trial. In the past we found infected Vidal Blanc had larger berry size and Marquette and Vidal Blanc had high acid. Results suggest possible fruit composition implications of virus in hybrids, but the collection of data was impacted by: (a) low replication, and (b) the crop load has been highly variable with the freeze damage the KRDC vineyard has sustained over the years. A second major finding was differences in bud viability between virus-infected and virus-free plants in the wake of a winter freeze event in early 2023. Temperatures were cold enough that bud viability in the two more sensitive varieties (New York Muscat and Seyval Blanc) was close to zero, regardless of virus status. However, for the two hardier cultivars (Marquette and Marechal Foch), the vines were only partially damaged and so measuring the impact of virus was possible. For the Marechal Foch, the bud viability of virus-free plants was 28% greater than in virus-infected plants. For Marquette, the buds of virus-free plants were 39% more viable than in virus-infected plants. This is the first time such findings have been found in a hybrid cultivar.

Weekly inspections for known vectors were conducted annually and confirmed very low and localized populations of Grape mealybug (Pseudococcus maritimus). Fruit lecanium scale (Parthenolecanium corni) was observed in commercial sites but did not correlate with leafroll virus status. To date, numbers do not warrant sprays to manage. The potential vector of GRBV, Buffalo Treehopper (Stictocephala alta) was commonly observed in sweeps within laneways. Cane girdling was observed in blocks with confirmed GRBV but insects were not observed feeding. The risk of increased incidence of grapevine viruses is likely linked to infected nursery material, since vector pressure remains very low in Nova Scotia. Local producers support the need for research to develop best practices for virus mitigation. Access to virus-free plant material and knowledge of sustainable vector management tools has become a major priority for our industry, especially given the current virus status and continued expansion in acreage in NS, observed trends in regional climate change, and shifts to organic production systems. Research observations and preliminary trends have been shared with cooperating growers and industry stakeholders in annual reports and presentations to the Grape Growers Association of Nova Scotia, Nova Scotia Department of Agriculture, Canadian Grapevine Certification Network, and AAFC researchers and collaborators working on grapevine viruses across Canada.

Part II: Distribution and impact of emergent and invasive insect pest species in the context of viticultural expansion in Nova Scotia

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To determine the distribution and impact of emergent and invasive insect pest species in the context of viticultural expansion in Nova Scotia, two objectives were established: (1) to determine the incidence and distribution of Phylloxera and (2) to assess the presence of pest status for other potential endemic and invasive insect threats. Efforts in 2020 were significantly impacted by pandemic restrictions that prevented access to commercial sites. An intensive trial was established in a research vineyard located at the Kentville Research and Development Centre (KRDC). The study focused on understanding the seasonal dynamics in soil emerging phylloxera, based on counts, and how this related to the presence of leaf galls, ambient air and soil temperatures, and vine phenology. Trapping was done using a non-invasive technique with plastic buckets that captures phylloxera nymphs as they emerge from the soil. In 2021, trials were extended to include 4 commercial vineyards. Weekly counts continue to be highly variable within varietal blocks and between varieties. Annual observations showed sustained catches for soil emerging stages to be in mid-June for all varieties assessed and was approximately 1 to 10% of the subsequent summer peak.

Over the duration of the study, both ambient soil and air temperatures were statistically correlated with the soil emergence counts. Soil temperatures between 21 and 25°C at a depth of 30 cm were correlated with the highest emergence levels. These temperatures were consistent with previously reported temperatures for nymph survival (21-28°C). Air temperatures were also significantly correlated with emerging counts but, not unexpectedly, were more variable than soil temperatures. Phenology stages around rapid shoot and inflorescence development and berry development were associated with the highest emergence numbers. Results suggest that phylloxera populations were already established in all the varietal blocks included in this study and counts recorded throughout the sampling period, reflected seasonal dynamics of local populations. Emergence counts for vinifera Chardonnay and Riesling varieties showed comparable trends, whereas, hybrid varieties varied considerably. L'Acadie Blanc consistently showed low emergence and leaf gall counts and highest populations were observed in Marquette, with an approximate 1000 times difference between L'Acadie Blanc and Marquette. General observations of leaf gall presence throughout the entire vineyard showed that phylloxera populations moved throughout the vineyard over the growing season and dispersal was likely facilitated by the direction of prevailing wind patterns, machinery and labourers. A small pilot trial was established to observe the fate of phylloxera in leaf galls after canes were pruned and left on the ground within the vineyard aisles. Of interest, was that phylloxera crawlers exited galls on pruned canes and moved up the walls of the container suggesting that infested prunings could potentially act as a reservoir within the blocks if left within the aisles. What is not known is the distance that crawlers could potentially move and if vines could be reinfested. Dispersal is likely facilitated by prevailing winds. Incidence and overall level of infestations observed each year appear to be on the increase. Although gall presence remains the obvious measure for vineyard managers to use for

decision-making as to whether to manage, it is likely an underestimate of the actual population that exists within the vineyard. Leaf gall counts on vines were not found to be significantly correlated with the timing of highest soil emergence counts and the delay may be explained by the gap in time between when active stages emerge from the ground and the time it takes for galls to form on the leaves.

In 2022, wildflower treatments were evaluated for their potential to attract key predator species, like hoverflies, and impact to phylloxera populations. Four species of plant hosts (Daucus carota (wild carrot), Coriandrum sativum (cilantro), Lobularia maritime (alyssum), Thymus serpyllum (thyme)) were established at the head of rows. Species from 7 taxonomic groups of interest (Ichneumonidae, Braconidae, Coccinellidae, Carabidae, Diptera, Neuroptera, Arachnids) were targeted in weekly sampling. Bucket traps were sampled weekly to determine counts of phylloxera emerging from soil and number of winged (alates) and crawlers (aptera). Leaves of vines in panels with traps were assessed for galls. Early findings of visual assessments of wildflowers showed that cilantro attracted the most potential predators, primarily hoverflies. Alyssum was also an attractive host to hoverflies. Generalists like lacewings, spiders, and carabids were also observed on occasion. Thyme was the least visited. Proximity of trap to wildflowers did not seem to suppress pest emergence counts over time. Likely because the wildflower plots had only just been established and size in proportion to the vineyard block would not have been sufficient to be measurable. However, predator counts by wildflower host suggests that cilantro and alyssum may be good candidates for promotion of biological control, if plots of sufficient size. Efforts going forward need to focus on enhancing non-cropping spaces within and around commercial vineyards to develop potential reservoirs of beneficial species that would contribute to pest suppression and management, especially in organic systems. The greatest threat remains for producers of non-conventional production systems, where there are no effective control products available for use on this pest. Further research is needed to evaluate alternative control options.

Monitoring for other invasive and emerging species was done annually. Visual observations for presence of Japanese beetle in vineyards not previously known to have this pest, confirmed the continued spread in distribution. We did not observe Grape Berry Moth larvae in clusters. Various leafrollers were collected and reared, with the majority identified as Redbanded leafroller (Argyrotaenia velutinana), a common Tortricid in Nova Scotia. Malaise trap samples from 2023 are still being barcoded to determine species identification. Monitoring did reveal observed damage in vinifera grapes from spotted wing drosophila (Drosophila suzukii). Typically, this has not been considered a pest of interest in grape and damage may have been a result of multiple factors that included warm, humid temperatures that supported higher populations and fruit (especially thinner-skinned varieties…mostly vinifera) left to hang longer with the favourable Fall conditions. Higher than usual levels of sour rot were observed and may have been affected by the wounds caused by egg-laying that can contribute to development of the disease. Given changing climate trends, spotted wing drosophila should be monitored from veraison and on. Damage was sufficient to cause some growers to want to schedule maintenance sprays but this would present challenges around harvest. Work is needed to determine best timing of management tactic, with a growing interest in incorporating

wildflower plots as refuges for beneficial species, especially in organic production systems. As in previous years, specimens and/or images of pest species of interest were routinely received by growers and identified. Commercial vineyard monitoring efforts for other invasive and emerging insect pests included grower education and increasing awareness of potential pests and their associated risks. Newsletters 'AAFC Pest Update' were produced and disseminated to growers through the Grape Growers Association of Nova Scotia. Regular communications were ongoing with AAFC, the Canadian Grapevine Certification Network, Grape Growers Association of Nova Scotia, and wine-grape growers and stakeholders.