

CLEAn plAnt extraction SEquencing Diagnostics (CLEANSED) for Virus-free Grapevines in Canada



MEET THE RESEARCHER

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The Niagara Agriculture Municipal Learning Network (NAMLN) is an initiative to build capacity within the municipalities of Niagara to support and promote a sustainable, competitive agriculture industry. NAMLN is led by the Niagara Community Observatory at Brock University with funding from the Canadian Agricultural Partnership through the Ontario Agri-Food Research Initiative of the Ontario Ministry of Agriculture, Food and Rural Affairs. For more information about NAMLN, go to <https://brocku.ca/niagara-community-observatory/namln/>

The Problem

Canadian grape growers need an estimated 6.7 million grapevines every year for regular vineyard maintenance, expansion, and to replace vines damaged by cold or infected by viruses. Grapevine viruses decrease the quality and yield of fruit and the lifespan of the vineyard. Grapevine viruses cause an estimated 14% loss (\$23m) in farm gate value, annually. There are no ‘cures’ for grapevines infected with a virus. Infected vines must be replaced with virus-free vines. To protect the Canadian grape and wine sector from devastating viruses, clean plant programs must test domestically sourced and imported grapevine planting material to ensure they are free from known and emerging viruses. Current testing methods are effective but expensive and time-consuming. The Canadian grape and wine industry needs clean plant programs with rapid, accurate, cost-effective and comprehensive testing and diagnostic tools.

The Research

My research focuses on the detection, epidemiology, diagnostics, disease monitoring and management of viruses impacting horticultural crops. I am currently working with researchers from the Canadian Food Inspection Agency (CFIA), Agriculture and Agri-food Canada (AAFC) and the [Canadian Grapevine Certification Network](#) (CGCN) to develop and implement a genomics-based grapevine virus screening method called high-throughput sequencing (HTS). HTS allows for the rapid, comprehensive testing of all known plant viruses and virus-like agents in one single test. The research project “[CLEAn plAnt extraction SEquencing Diagnostics tool](#) (CLEANSED)” is funded by [Genome Canada](#). The project has three objectives 1) develop better viral genome extraction and enrichment methods and automate HTS, 2) optimize a web-based application and database for managing and analyzing grapevine virus sequence data and 3) validate the complete, fully integrated and automated HTS technology for use in clean plant programs and regulatory purposes.

High throughput sequencing has several steps. The first step is extracting viral genetic material from the leaves or canes of infected grapevines. Next, the extracted genetic material is enriched before sequencing. Sequencing is a process of identifying the genetic code (genome) of different virus species and their variants. The genetic code is unique for each virus and can therefore be used to diagnose which virus(es) are present in the infected grapevine. Sequencing enriched virus genetic material generates massive amounts of sequence data (strings of recurring genetic molecules or nucleotides), which must be read and interpreted to identify whether and which virus(es) have infected a grapevine. Identifying viruses in grapevines involves comparing genome sequences from the grapevine samples with known virus genome sequences that are stored in a reference sequence database. We are developing a specialized reference database and an integrated set of sequence data analysis and interpretation processes for grapevine viruses in collaboration with CFIA. This is a complex process that involves developing a large number of HTS datasets of grapevine viruses, developing algorithms for accurately differentiating the virus genome sequences from non-virus sequences in the samples, and identifying new and novel grapevine viruses whose sequences have not been determined.

The Implications

The CLEANSED research outcomes will be used by both CGCN and CFIA for improving the accuracy and comprehensiveness of screening viruses in grapevine clean plant programs and for regulatory purposes. CLEANSED will replace over 30 molecular bioassays currently used to identify infected vines with a single test. The time that grapevines spend in traditional clean plant programs will decrease from three years to one year. These reductions will allow CGCN and CFIA to test and certify more grapevines in less time resulting in an increased supply of virus-free planting material to nurseries and grape growers. The virus testing facility at Brock’s [Cool Climate Oenology and Viticulture Institute](#) is accredited by the CGCN for the certification program. We will use the research from the CLEANSED project to develop a comprehensive and cost-effective HTS method for grapevine virus testing. Beyond the economic benefits, there will be more domestic virus-free grapevine planting material available to serve the needs of the Canadian grape and wine industry.