

Executive Summary

This project aims to perform a large-scale of grapevine genotyping using our newly developed grapevine genetic test to build a genotype database for Canadian grapevine cultivars and clones, as well as to develop software for streamlined processing of the genetic testing data and result reporting.

The project was carried out from May 1 to July 31, 2022 (with a 3-month no-cost extension), and we successfully completed the project, fulfilling the proposed objectives and specific activities.

Specifically, we have collected a total of 55 grapevine samples from the Niagara vineyards and Brock greenhouse covering 40 different grape cultivars and multiple clones for 3 cultivars and 39 samples for cultivars and clones from the Canadian Grapevine Certification Network (CGCN), plus additional samples of grapevine rootstocks from commercial and proprietary sources. Genomic DNA were obtained from these samples and subjected to genotyping using our newly developed grapevine true-to-type test. Our new test involves the use of proprietary novel short-tandem repeat (STR) markers with their PCR products assayed on QIAGEN QIAxcel Advanced system to offer lower cost and faster turnaround time than the traditional STR genotyping method. The test is designed also to support future upgrade to genotyping using next generation sequencing platforms. A database of grapevine genotypes was developed with the genotype data for the collected samples as a starting point and is subject to future expansion with data for new samples. A computer pipeline was also developed to process testing results, perform matching to the samples in the database, and call the closest match(s) cultivars/clones.

In conclusion, as a result of the project, we established a grapevine genotype database and related resources for a new grapevine true-to-type test, making such a testing service available for first time in Canada for the grape and wine industries with better affordability and convenience.

3. Detailed Description of the Project:

a) Objectives and Project Input

The project has the following two specific objectives:

1. Perform large-scale grapevine genotyping for ~100 grapevine samples
2. Develop a genotype database and a genotype processing software

The inputs for the project included the following items:

- 1) \$50,000 funding in cash from OGWRI for purchasing the reagents and supplies for carrying out the required sample analysis and for paying the trainees (2 MSc, 3 co-op terms for two co-op students, and a Honours thesis student) to carry out the work.
- 2) Brock University Graduate Scholarships in the amount of \$15,000 (\$7m,500/each per year) as cash contribution for supporting the two MSc students.
- 3) In-kind contribution in the form of salary support to the principal investigator Dr. Liang's significant amount of research time on the project (>10% over the one-year project period), as well as the contribution of expertise and effort from collaborators, Drs. Jim Willwerth (for collecting samples from Niagara vineyards and Brock greenhouse) and Sudarsana Poojari (for discussion on research design), as well as the working hours of Dr. Bhadra Venulapti (a postdoctoral fellow of Dr. Poojari) and Mr. Tony Wang (a technician working with Drs. Poojari and Inglis) for running the PCR samples on the QIAXcell equipment required for the genotype component.
- 4) In-kind contribution in the forms of equipment uses at Dr. Liang's laboratory and the Cool Climate Oenology and Viticulture Institute (CCOVI) at Brock University and uses of liquid nitrogen required for the DNA extraction step.

b) Project Activities and Outputs

The project has the following 4 specific activities:

1. Collect a total of ~100 grapevine leaf samples from Ontario vineyards and CGCN repositories at the CFIA Clean Plant Program at Sydney, British Columbia
2. Extract DNA for the grapevine samples
3. Perform genotyping for all grapevine samples
4. Develop genotype database and cultivar identification software

For activity #1, we have collected a total of 55 samples from the Niagara vineyards and Brock greenhouse covering 40 different grape cultivars and multiple clones for 3 cultivars and 39 samples for cultivars and clones from the Canadian Grapevine Certification Network (CGCN), plus 76 samples from Dr. Helen Fisher for representing 29 sessions of grapevine rootstocks from different regions on Ontario. This surpassed our initial goal of collecting ~100 samples.

For activity #2, we completed the DNA extraction for all 94 samples from Niagara and CGCN, plus 46 samples for Dr. Helen Fisher's collection of grapevine rootstocks. It also surpassed our initial goal.

For activity #3, we completed the genotyping of all samples described in from activity #2, using our newly developed grapevine genetic test.

For activity #4, we successfully developed a computer pipeline for processing the genotype type data and calling the grapevine identity.

c) Reach and Communication

The project outcomes have been and will be presented as part of the theses for two MSc students and an undergraduate Honors' thesis. Among these, the two MSc theses will be made available for public access digitally on the Brock University's website for theses. Later, the developed test will be introduced to the Niagara grape community via seminars hosted at CCOV by the principal investigator, Dr. Ping Liang, and through formal journal publication(s) to the world-wide research community. We may expect local media report (radio, website, and news letters) on the availability of the grapevine genetic testing service in Canada. In all publications and communication, the support of OGWRI will be acknowledged.

4. Project Outcomes (actual vs. expected) at short and long-term

a) Short-term

- Outline the actual short-term outcome compared to the expected: the project delivered the expected outcome by creating the required testing protocol, the grapevine genetic database, and the related analytic tools, which are required for making the developed grapevine genetic test as a commercial service to the users in the Canadian Grape and Wine Industries. The project also provided the training of several graduate students and undergraduate students.
- *Identify the public good/benefit of the project*: the successful completion of the project addressed the need for a grapevine genetic testing service in the Canadian Grape and Wine Industries with much improved affordability and accessibility compared to the limited and cumbersome service available abroad (e.g., US). This will not only facilitate Canadian grape grower, nurseries, and governmental agencies to provide clean and certified but also place Canada as an international leader in the field.
 - The current intent/plan is to make the developed grapevine true-to-type testing as a commercial service to Canadian user, which will be significantly lower in cost with a much short turnaround time compared to a similar service at USA by avoiding the very cumbersome cross-border biomaterial shipping. The much-improved availability of such service could be used to justify the requirement of genetic identity certification of all commercial grapevine materials (plants and germplasms) to protect the rights of grape growers and nurseries and wine consumers.

b) Long Term

- The number of jobs created: running the grapevine genetic testing as a fee-based service to the users in Canadian Grape and Wine Industries can create 2 to 3 long-term jobs.
- Increased use of Ontario products: the readily availability of the grapevine genetic testing service will help the grape growers to ensure the quality of their products via the certification of their existing vines and use of certified grape plants for new planting. This will help increase the consumers' confidence for their products and can also facilitate research and development of new grapevine varieties, both of which will benefit the industries in a long run.

5. Final Comments and Conclusions

- Identify any deviations from the project workplan, budget or schedule and discuss the effects of the deviations and the solutions
- Provide a discussion of “lessons learned”, recommendations and overall perception of project success

While the project had experienced a one-year postponing for its start due to the COVID pandemic and a few challenges during the course of the project, it is a great achievement that we managed to complete the project in full and beyond the original goal in some aspects. In addition, while the current version of the grapevine test was designed for affordability and short turnaround time, it is also designed to accommodate future updates by adopting new technologies in the field for improved accuracy. With our design, it is possible to make more than one version of the testing available to tailor for different users and purposes.