BC Report to the NCCC 212 committee on small fruit and viticulture – October 2020

Objective 1: Develop improved small fruit germplasm through cooperative breeding and evaluation programs

1. British Columbia Berry Breeding Program: Dr. Michael Dossett, BC Blueberry Council (BCBC), Raspberry Industry Development Council (RIDC), BC Strawberry Grower's Association (BCSGA)

The BC breeding program focuses on blueberries, raspberries, and strawberries, and is led by the industry associations, in cooperation with Agriculture and Agri-Food Canada (AAFC), using levy dollars as matching funds for grants.

This year's biggest challenge was access to lab and field facilities due to the COVID-19 Pandemic. The program was able to successfully mitigate much of this and was able to continue with crosses and harvesting trial plots. Planting new trial plots was delayed but still proceeded. Molecular projects in the lab have been put on hold because of COVID, but we plan to start resuming those activities early in the new year. Unfortunately, the COVID situation limited access to greenhouses during the time in which trial material was slated to be sent to nurseries for contract propagation, so we are expecting a delay in when trial plants for the next round of advanced selections will be ready.

Blueberries

New seedling selections in the program continue to be noted for making progress in fruit size and quality, particularly firmness. Due to the COVID-19 pandemic, we were unable to do our usual bruising assays in the lab. Pollination across the region was hampered by a week of cool showery and blustery weather followed by a very unusual weather pattern for 3 days with very warm temperatures (87° F) and a strong sustained east wind during peak bloom. This weather discouraged bee activity and dramatically shortened the receptive period of flowers that were open. We were monitoring flowering closely during this period as we were doing emasculations and crosses daily in the breeding plots and this weather caused flowers to progress from opening to corolla fall in 48 hours or less.

Yield data is still being analyzed, but one selection is being scrutinized particularly closely. BC 14-40-158 has medium-large fruit and excellent quality. It ripens shortly after Draper in the Bluecrop season. Firmness is similar to Draper. It initiates flower buds earlier than most selections with fat flower buds often apparent in early-mid August. As a result, it initiates flower buds over an exceptionally long length of the new growth, often for as many as 25 nodes or more from the shoot tip, and has shown the potential to have very high yields. Tests this last season showed that it had good self-fertility with no deficit in fruit size from selfed flowers as compared to crosses with Duke, Draper, Bluecrop, and Elliott. On some sites it showed good pollination while on others it showed poor pollination this last season. We will continue to evaluate it for potential. Two selections,

BC 14-8-76 and BC 12-6-8 will be distributed for trial plantings as part of the collaborative CBTN trials (see below) in the spring. BC 14-8-76 is slightly later than Duke but is firmer and larger. BC 12-6-8 is exceptionally firm and ripens slightly later than Draper. It has an upright vase-shaped growth habit and somewhat willowy growth but does not yield well on younger wood.

Raspberries

In the 2017 Machine Harvest Trial, BC 10-71-27 (1.55 kg/plant) was the highest yielding selection, followed by WSU 2188 (1.24 kg/plant), compared with the standard 'Chemainus' (1.04 kg/plant). Both harvested exceptionally well by machine and had good fruit quality. BC 10-71-27 was about a week earlier than WSU 2188. In the 2018 Machine Harvest Trial, WSU 2069 (2.12 kg/plant) and BC 13-31-9 (2.03 kg/plant) were the standouts, with significantly more fruit than 'Meeker' (0.46 kg/plant) or 'Chemainus' (1.21 kg/plant). Both had nice quality, with WSU 2069 being especially nice.

We are currently conducting a large study to examine heritability and correlations between various yield components, yield, fruit quality, and seasonality. The aim is to try to identify selection criteria that will allow us to more effectively put selection pressure on yield and earliness simultaneously, an objective that is difficult because these two traits are negatively correlated. We also received funding in 2020 to work with an economist to help develop a selection index based on grower profitability. As the breeding program continues to increase the proportion of selections that machine harvest easily and show nice quality, this will further help separate those which are worth pursuing and those which are candidates for elimination by estimating and ranking their economic potential for growers and more accurately taking into account economic tradeoffs such as yield with earliness (greater percentage of fruit into IQF grade before processors stop taking IQF fruit for the season in favor of blueberries).

Strawberries

Our strawberry trials this season included our first look at advanced selections from the breeding program in Kentville as well as some of their new releases. Of the new releases from Kentville, the June-bearing AAC Kate was very large and had particularly nice fruit quality, though we noted that the fruit size dropped off and there was a big mix of sizes that needed to be sorted/graded after the primary berries were gone. Our day-neutral selection BC 10-2-1 performed well with yields that were better than Albion and which came back into bearing about a week earlier in July after the first flush. Unfortunately, we noted that BC 10-2-1 seemed to be significantly more prone to fruit damage from rain than Albion, with cracks and subsequent decline in fruit quality being noted. As a result, it is likely that it will not find a home for open field production and may be limited to situations where it is protected by high or low tunnels.

2. Canadian Berry Trial Network: Dr. Beatrice Amyotte, Research Scientist, AAFC's KRDC (Nova Scotia); Dr. Pierre Lafontaine, Director, Carrefour Industriel et Experimental de

Lanaudiere, and Jennifer Crawford, Executive Director, Association des Producteurs de Fraises et Framboises (Quebec); Dr. John Zandstra, Professor, University of Guelph (Ontario); Dr. Eric Gerbrandt, Plant Scientist, Sky Blue Horticulture Ltd. (BC).

The final stage of the breeding program prior to commercialization is to evaluate advanced selections under commercial conditions through grower trials. This portion of the program has been linked with programs in Ontario, Quebec and Nova Scotia to build a network of trials, each region evaluating the other's selections against standard cultivars. Two initial rounds of exchange of raspberry and strawberry selections and cultivars took place in 2019 and 2020 with selections from the Kentville and BC programs being distributed for replicated trials in each province. A first round of blueberry trials is being planned for spring of 2021. These trials will implement replicated comparisons of a range of industry standard cultivars, new cultivars, and non-commercialized selections from a few different breeding programs.

On-farm grower trial evaluations of existing raspberry, strawberry and blueberry trials. In 2020, this included intensive sampling to compare blueberry fruit firmness over five weeks in cooler storage.

Objective 2: Develop practices for small fruit production tailored for climatic and market needs of growers

1. Developing a decision support system for mitigating fruit rot diseases of berries: Dr. Rishi Burlakoti, Research Scientist, Agassiz Research and Development Centre (ARDC), Agriculture and Agri-Food Canada (AAFC)

In Agassiz Research and Development Centre (ARDC) and at the Clearbrook substation, fruit rot forecasting model prototypes were deployed to compare the model-based fruit rot infection risk and fruit rot incidence in fields. In Agassiz, one field trial for blueberry ('Bluecrop') and raspberry ('Meeker' and 'Chemainus') were conducted to evaluate the model-based fungicide spray and calendar-based fungicide spray programs in managing fruit rots of raspberry and blueberry. Fruit rot were assessed by collecting fruit samples from multiple varieties of blueberry (including selections from the BC Berry Breeding Program in Abbotsford) from both sites. Blueberry and raspberry fruit samples were also collected from growers' fields from diverse regions and fruit rot was assessed.

2. Managing berry root health through pathogens characterization, developing screening methods, and exploring good management options: Dr. Rishi Burlakoti, Research Scientist, Agassiz Research and Development Centre (ARDC), Agriculture and Agri-Food Canada (AAFC)

Two field trials, each at ARDC and a grower's field in Abbotsford, were conducted to evaluate different fungicide products in managing the root rot complex of raspberry. In Agassiz, confined field areas were built to inoculate with pathogens and evaluate the effects of control products, whereas a naturally infected site was used in a grower's field in Abbotsford. Treatments were applied in the spring and foliar symptoms were assessed at both sites. In addition, several growers' raspberry fields in Abbotsford were monitored to assess the root rot and wilting complex, and infected plant material were collected to isolate the causal agents.

3. 4. Integrating host resistance and alternatives to copper-based products for sustainable management of bacterial blight: Dr. Rishi Burlakoti, Research Scientist, Agassiz Research and Development Centre (ARDC), Agriculture and Agri-Food Canada (AAFC)

A long-term field trial was maintained in spring and summer. Isolates of *Pseudomonas* collected in 2018 and 2019 were revived regularly from long-term storage to maintain isolates. Blueberry fields at the research centre and in growers' fields were visited to monitor for bacterial blight and to collect disease samples.

4. Monitoring of arthropod pests in raspberry and blueberry germplasm: Dr. Michelle Franklin, Research Scientist, Agassiz Research and Development Centre (ARDC), Agriculture and Agri-Food Canada (AAFC)

The objective of this project is to provide the BC berry breeding program with information on the relative susceptibility or resistance of advanced selections to key arthropod pests will inform decisions about release and management of new cultivars of blueberry and raspberry. Analysis of the first year of data from 2019 suggests that there may be differences in susceptibility to aphids among cultivars that appear to be repeatable across sampling sites, with some new selections of blueberries consistently having lower aphid population densities than standard cultivars ('Duke', 'Bluecrop'). More years of data are needed, however, before these trends can be considered reliable. We are also exploring the potential for implementing binomial sampling plans for aphids in BC berries, which could greatly facilitate future evaluations, and initial results are promising.

5. Improving establishment of blueberry and raspberry with non-traditional crop inputs: Dr. Eric Gerbrandt, Plant Scientist, Sky Blue Horticulture Ltd.

For blueberry and raspberry, the objective of this project is to enhance crop establishment, yield and fruit quality through comparison of drench applications of four classes of alternative crop inputs (i.e., high P fertilizer, phosphites, humic acids and kelp extracts). Following pilot trials using potted plants, large replicated-field trials were established for blueberry and raspberry in 2017 and 2018, respectively. In 2020, the

blueberry component of this trial is in its fourth field season. Collection of field data from each experimental plot included soil sampling, leaf and fruit tissue sampling, harvesting of all fruit and measuring fruit quality parameters (e.g., average fruit size, firmness and shelf-life). For the raspberry component of this project, a third field season included soil sampling, leaf and fruit tissue sampling, harvesting of all fruit to assess yield and measuring fruit quality parameters (e.g., average fruit size).

6. Mitigating cultivar-specific physiological challenges in new blueberry cultivars: Dr. Eric Gerbrandt, Plant Scientist, Sky Blue Horticulture Ltd.

A first aspect of this project is focused towards solving specific fruit quality issues being seen in newly introduced blueberry cultivars, such as reducing splitting, shriveling and loss of firmness in cooler storage with a focus on 'Calypso', 'Last Call' and 'Cargo'. A third year of implementing differential irrigation and fertilizer rates in new cultivars of blueberry was used to complete the current set of trials. This included determination fruit size, resistance to splitting, and firmness during cooler storage.

A second aspect of this project is aimed at characterizing the heritability of Green Fruit Drop (GFD) in advanced selections in the BC Berry Breeding Program with the long-term goal of developing molecular markers to screen for this physiological disorder. To address the issue of GFD in 'Draper' blueberry (and other cultivars and breeding selections with 'Draper' in their pedigree), a region-wide survey of leaf and fruit nutrient allocation continued into a fourth season. Also, GFD management trials were implemented across multiple sites to evaluate transferability of an effective foliar calcium solution developed for GFD on 'Draper' to one new cultivar (Valor™) and one advanced breeding selection (BC 14-40-158) with 'Draper' in their pedigree.

7. Management of soil-borne pests and diseases in raspberry and strawberry: Dr. Eric Gerbrandt, Plant Scientist, Sky Blue Horticulture Ltd.

This project seeks to improve management tools for soil-borne pests and diseases, especially nematodes and Phytophthora root rot, to increase fruit yield and quality in raspberry and strawberry. In 2020, a new set of field trails was initiated to compare the effects of three different pest control products for their effects of plant parasitic nematodes and plant growth responses to soil-borne disease pressure. Nematode populations were assessed prior to trial implementation, and they are currently being re-evaluated after application of experimental treatments.

8. Implementing Integrated Pest Management Practices on Small-Scale Farms: Marjolaine Dessureault, Research Director, ES Cropconsult Ltd.

Working with blueberry, raspberry and strawberry growers, this project's objective is to develop IPM training materials for small-scale fruit and vegetable growers to handle shifts in pest pressure due to climate change and to improve region control. A short-list of target

pests was identified this season and will be used to develop grower education materials in the next year. A short-list of target pests was identified in 2019. In 2020, this project developed IPM management guides for 14 different pests.

9. Ecological Pest management for Spotted Wing Drosophila: Dr. Juli Carrillo, Assistant Professor, University of British Columbia

With support from the blueberry, raspberry and strawberry industries, this project is aimed at developing alternative methods of SWD control to reduce regional pressure and reliance on chemical tools. This includes the evaluation of intercropping options to repel SWD, developing better attractants for lures and traps and the establishment of effective biological control species in the region.

10. Evaluating mass trapping as a tool for non-chemical spotted wing drosophila management: Allyson Kang, IPM Consultant, ES Cropconsult Ltd.

The objective of this project is to evaluate mass trapping as an option for reducing SWD pressure in conventional and organic settings. In 2019 and 2020, this study was conducted in fields of 'Draper', 'Bluecrop' and 'Liberty'.

11. Non-Chemical Vole Control in Berry Fields: Sofi Hindmarch, Project Coordinator, Fraser Valley Conservancy

The objective of this project is to assess the effectiveness of a non-chemical option for killing voles. The project is using a commercial trap that has a self-resetting and has a bolt-action kill mechanism with the potential to reduce impacts on non-target wildlife as compared to rodenticides.

12. Assessing Harvest and Postharvest Fruit Quality in Blueberry: Dr. Simone Castellarin and Dr. Anubhav Pratap Singh, University of British Columbia

The objectives of this project are to assess fruit quality of current blueberry cultivars as well as advanced selections from the BC breeding program at harvest and at various times postharvest during cooler storage. This will permit the determination of biochemical constituents of fruit quality and how they change over time. This project also includes evaluation and development of postharvest treatments and advanced packaging materials for their ability to improve shelf-life will be used to improve shipping range for industry standard cultivars. In 2019 and 2020, fruit samples of selections from the breeding program as well as standard cultivars from commercial fields were provided to this research group for the first year of this study. Analysis of first year data is currently underway. There is a team of graduate and post-doctoral researchers working on various projects to elucidate the biochemical basis for fruit quality and develop post-harvest storage methods to extend fresh market shelf life.

13. Evaluation of spray-induced gene silencing of blueberry scorch and shock viruses as a method to reduce virus number and symptoms of infected blueberry plants: Dr. Jim Mattsson, Associate Professor, Simon Fraser University

The objective of this project is to design a biopesticide that can be used to prevent the spread of economically important blueberry viruses. The approach is to sequence the genetic code of the virus and then design RNA sequences that can inhibit replication of the virus when sprayed on the plant – spray-induced genomic silencing (SIGS).

14. Determining Optimal Wildflower Patch Arrangements to Minimize Pollination Deficits in Cultivated Blueberry: Dr. Rebecca Tyson, Associate Professor, University of British Columbia.

The objectives of this project include developing mathematical models of bee behaviour within blueberry fields to determine optimal placement of wildflower patches to foster native bumblebee populations to supplement honeybee activity during the blueberry pollination window; and analyzing pollen from "bee boxes" buried around blueberry fields to determine bumblebee movement in the landscape surrounding blueberry fields.

15. Controlling Blueberry Fruit Development using Plant Growth Regulators: Dr. Charitha Jayasinghege, Research Scientist, Agriculture and Agri-Food Canada

The objective of this upcoming project is to use plant growth regulators to de-blossom new plantings as well as delay the ripening season for various blueberry cultivars to shift the harvest window. This project was temporarily placed on hold due to COVID.

16. Development of Molecular Diagnostics for Plant-Parasitic Nematodes in BC: Dr. Tom Forge, Research Scientist, Agriculture and Agri-Food Canada

This project is aimed at development of a lab method for detecting nematodes in soil and root samples, filling a gap in diagnostic capacity for the local industry. This project was temporarily placed on hold due to COVID.

17. Development of PCR Based Methods to Reliably Distinguish Shock or Scorch Virus Infected Blueberry Plants: Dr. Jim Mattsson, Associate Professor, Simon Fraser University

The goal of this project is to determine strain variation for blueberry shock and scorch viruses to improve reliability of diagnostic tools available to the industry. This project addresses the potential issue of novel viral strains that are not detectable with the current version of the ELISA diagnostic test.

18. Effects of Host, Pathogen, and Environmental Factors on Increased Incidence of European Foulbrood in Honey Bee Colonies Pollinating Blueberries in BC: Dr. Sarah Wood, University of Saskatchewan

This project is focused on determining the effects of common pesticides on bee susceptibility to European foulbrood disease and assessing ways to improve bee nutrition and health.