Title: BC Cranberry Variety Assessment 2020 Progress Report

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Introduction:

The BC Cranberry Research Farm (BCCRF) provides a unique opportunity to evaluate newly developed cranberry varieties under the specific growing conditions of south western BC. While there are many microclimatic differences across the cranberry production areas in BC (e.g. Agassiz to Delta to Pemberton on the mainland, Campbell River to Ladysmith on Vancouver Island), performance of new varieties in Delta BC, is still more relevant than in Oregon, Washington or eastern North America.

In the first few years (2015 to 2018) of data collection efforts were primarily focused on documenting differences in yield amongst recently released (Crimson Queen, Mullica Queen, Demoranville, BG), newly released (Valley King, Midnight series, Haines and Welker) and unreleased varieties (e.g. RS99-9-25). The result of the work at the BCCRF and other field sites across North America has resulted in the recent release of RS99-9-25 as Vasanna, by Rutgers University. Additionally, the variety RS98-11 has shown to be a promising candidate for late harvest and larger scale plots are being planted at the BCCRF.

Yield however is only one characteristic of a cranberry variety that is important to understand. In order to optimize performance a variety must be managed for growth and pests. Many management steps are tied to the phenology of the cranberry plant. For example, fungicide applications for fruit rot protection are tied to %bloom, insecticide applications for cranberry fruitworm are tied to %out-of-bloom and monitoring data. Our data, from the past several years, show trends in bloom phenology that indicate differences across varieties that remain consistent from year-to-year – e.g. Crimson Queen is one of the earliest to bloom and Haines is one of the last to bloom (Fig. 1). Thus, the different varieties may require different timings for phenology related management activities. In highbush blueberries, the differences in bloom and fruiting across the different varieties grown in the Fraser Valley are well established and helpful to growers in managing activities such as pollination and pest management.

The objectives of the 2020 field season at the BCCCRF were as follows

1. Document differences in bud phenology (dormant to bloom) for released and some numbered cranberry varieties,

2. Document differences in bloom and out-of-bloom phenology for released and some numbered cranberry varieties

3. Document yield differences in all released and numbered varieties grown at the BCCRF

4. Document differences in berry characteristics (% poor, Firmness, colour) and potential incentive payments for released and some numbered cranberry varieties (this objective is done in collaboration with Oceanspray Canada)

This progress report provides a summary of Objectives 1, 2, and 3 for Bog 1 only.

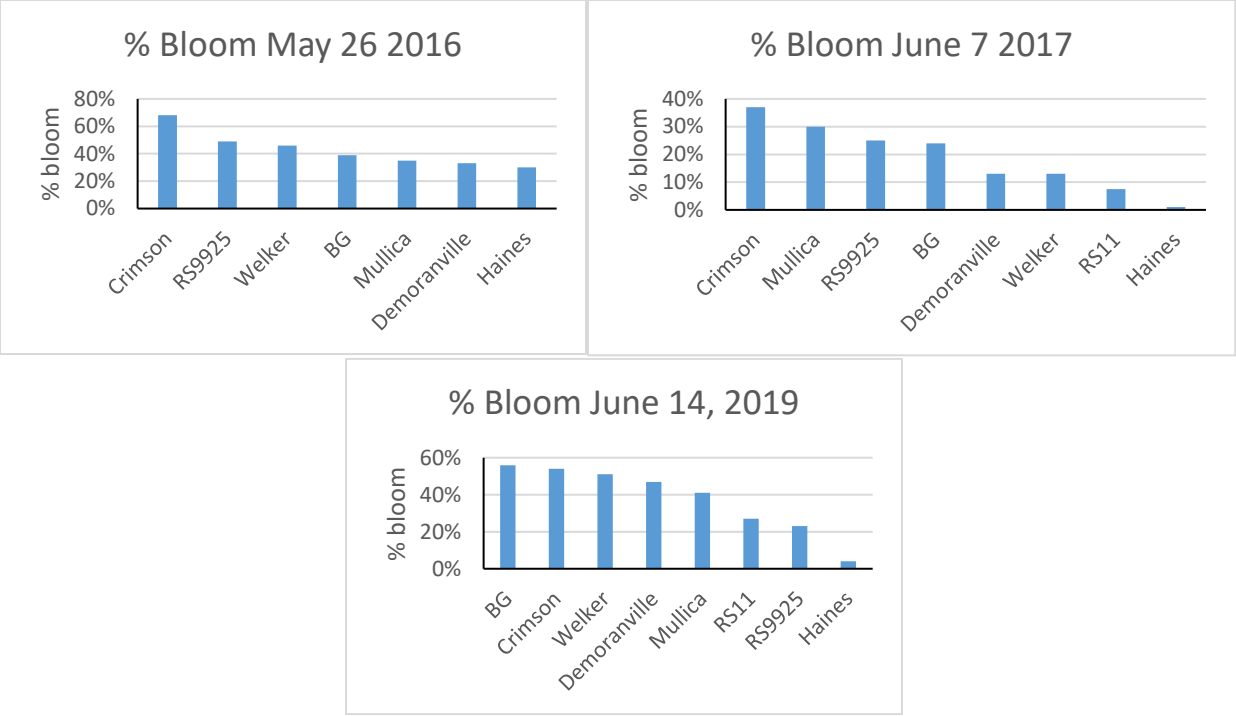

Figure 1. Bloom phenology of select cranberry varieties at the BC Cranberry research farm over three different years: 2016 (top left), 2017 (top right) and2019 (bottom).

Methods:

Phenology (Objective 1 and 2): Phenology was assessed from dormancy through to fruit stages (pinhead) in both Bog 1 and Bog 2. Bud phenology was assessed six times in Bog 1 the spring of 2020 – March 28, April 14, April 22, May 12, May 26 and June 9. Bloom and out-of-bloom phenology were assessed three times in Bog 1 – June 25, July 2, and July 21.

In Bog 1, phenology was assessed by stopping at three random locations and determining the bud stage (using Fig. 1 from Workmaster and Palta, 2006) on 10 uprights/location. Similarly, bloom and out-of-bloom were assessed from three random locations and the number of (pods, flowers and pinhead fruit were counted on 10 uprights/location). Bloom and out-of-bloom were calculated using established formulae.

$$\%\ \text{Bloom} = \frac{\text{Total \# of flowers}}{\text{Total \# flowers and unopened flower pods}} \times 100\%$$

$$\%\ \text{Out-of-Bloom} = \frac{\text{Total \# of pinheads and berries}}{\text{Total \# pinheads, berries, flowers and unopened flower pods}} \times 100\%$$

(Source: University of Maine - https://extension.umaine.edu/cranberries/grower-services/calculating-out-of-bloom/)

Yield (Objective 3): We continue to harvest cranberries at the BCCRF using methods established in 2015 and used consistently for the past six years. Specifically, yield data were collected following the protocols developed and reported on in previous reports (see 2016 Final Report). In Field 1, square-foot quadrats were placed randomly within the centre of the plot – within 2-m of the sprinkler line, ensuring that the location had 100% cranberry cover and no weeds. In Field 2, square-foot quadrats were placed randomly within the centre of the plot, 1-m from the edge. Berries were collected from Field 1 on two dates: September 22 and prior to harvest on October 6. For Field 1, berries were collected from three square-foot samples. Berries were collected from Field 2 on September 22 to 24. Because variety trial plots are much smaller in Field 2 only two square-foot samples were collected/plot. However, in Field 2 there are two replicates for each variety, so a total of four square-foot samples/variety. We collected a select number of varieties from the Rutgers 2013 planting, all of the Valley Corporation plantings, and all of the Rutgers 2015 and 216 planting.

Results and Discussion:

Objective 1

In the early part of the spring as cranberry buds break dormancy they are vulnerable to frost damage that can negatively impact yield for the current growing season. As buds develop they become increasingly more sensitive to cold temperatures (DeMoranville 1998). For example, as Stevens moves from dormancy (tight bud) to cabbage head to roughneck frost tolerances decreases from 20^{o}F to 30^{o}F or -6.7^{o}C to -1.1^{o}C. Crimson Queen, Mullica Queen and Welker were the earliest varieties to move from dormancy (tight bud) to bud swell between around mid-April. Thus, these variety would in theory be more susceptible to frost damage in April than those that are still dormant. However, impact of cold temperatures on cranberry buds has been shown to be very complicated and bud phenology is only a part of the story (Workmaster and Palta, 2006). For example, cranberry buds have been shown to vary in theory response to cold stress both within the tight bud stage and between tight bud and bud swell (Workmaster and Palta, 2006). Further, without the detailed information for each of the new varieties (e.g. see Demoranville 1998) tailored management recommendations for each variety are unlikely. However, growers could still use the information from Figure 2 (repeated over several years) to understand which of their varieties needs frost protection the earliest. By June 9, the earliest blooms were observed in Mullica Queen, Crimson Queen, Welker, BG and Vasanna. Consistent with previous work we observed that Haines was the latest to bloom among these seven varieties assessed in Bog 1 (Bog 1).

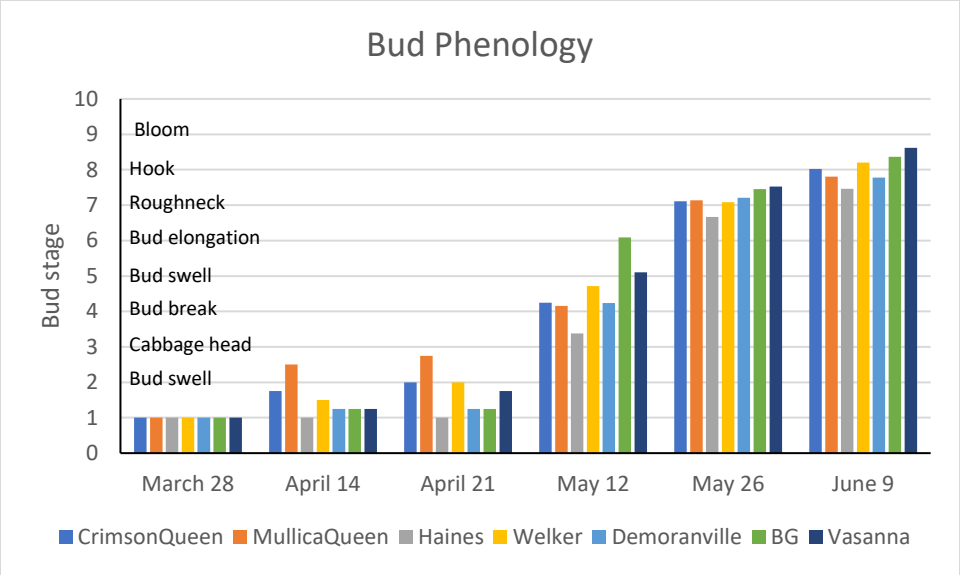

Figure 2. Bud phenology of seven cranberry varieties grown at the BC Cranberry Research Farm, Delta BC in 2020. Bars represent the mean of 30 uprights/variety/sampling date. Bud stages are based on Figure 1 in Workmaster and Palta (2006).

Objective 2 (Bloom and out-of-bloom): By late June only one of the varieties (Haines) was not at 50% bloom (Fig. 3). Early fruit set had started by the very end of June beginning of July for all varieties (Fig 3). The timing of bloom and fruit set has been shown to be critical for proper fungicide applications, since most fruit rot fungi infect during bloom and early fruit set (Oudemans *et al.* 1998). The varieties Crimson Queen and Haines have reliably been the earliest and latest to bloom, respectively. In contrast, the other varieties seem have different relative timings for bloom from year-to-year. For example, the variety Vasanna (formerly RS99-9-25) was one of the last to bloom in 2019 (Fig. 1) but one of the earliest in 2020 (Fig. 2) and it will be important for growers to monitor the timing of bloom in fields with those varieties.

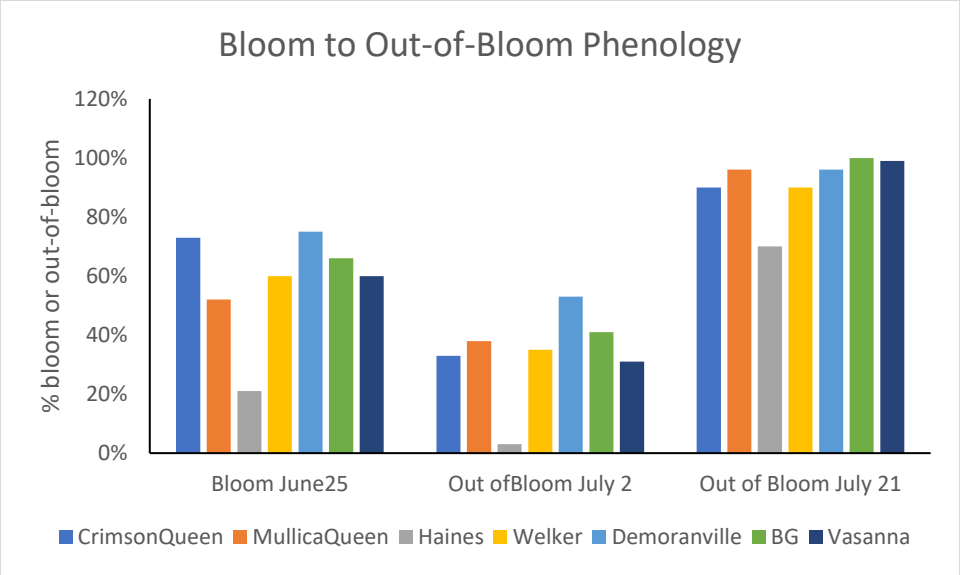

Figure 3. Comparison of bloom (June 25) and out-of-bloom status of seven cranberry varieties grown at the BC cranberry research farm. Each bar is the mean of 30 uprights for each variety.

Objective 3 (Yield): Based on our analysis to date, the highest yielding Field 1 variety In 2020 was Crimson Queen (Table 1), with an average estimated yield of 493 barrels of marketable cranberries/acre. The only other variety to have an estimated marketable yield over 400 barrels/acre was Vasanna (Table 1). Haines and Mullica Queen had similar yields as in 2019 and Welker had much lower yields in 2019 than in 2020 (Table 1). The 2020 foliar nutrient analysis revealed that all varieties from Field 1 had tissue N% values that were below the normal of 0.90 (see Table 2 in Davenport, Demoranville, Hart and Roper, 2000) (Fig. 4). With the exception of Mullica Queen, we observed that lower yielding varieties had lower foliar N% values (Fig. 4). The response of the new cranberry varieties to nitrogen application rates and timings has not been explored, for BC growing conditions, to our knowledge. However, previous work with older varieties shows that response to nitrogen fertilizer can vary not just in response to rate of application but also application timing and with confounding effects of soil/location (e.g. Fig. 7 in Davenport, Demoranville, Hart and Roper, 2000).

Table 1. Estimated average barrels/acre for 5 years for released and numbered varieties from the Rutgers breeding program (values are the mean of 3 samples, from Field 1, for the late September harvest)

	2015	**2016**	**2017**	**2018**	**2019***	**2020***	**6-Year Average**
CrimsonQueen	335.52	382.37	308.44	559.23	231.47	493.85	385.15
MullicaQueen	153.14	420.81	265.57	586.18	245.81	244.67	319.36
Demoranville	171.82	350.38	172.3	425.91	236.00	368.99	287.57
Welker	611.53	211.07	331.75	393.95	428.47	243.31	370.01

Haines	508.53	300.26	208.43	441.95	311.57	336.31	351.18
(Vasanna) RS99-9-25	473.18	457.53	532.48	410.46	311.66	442.60	437.99
RS-11	459.82	394.43	302.20	378.7	334.31	Field 2	Final Report

* Average barrels/acre estimate in all years is based on marketable weight – minimum size based on Ocean Spray Cranberries criteria. Minimum size for 2015 to 2018 = 9/32" or above; for 2019 and 2020 = ½" or larger.

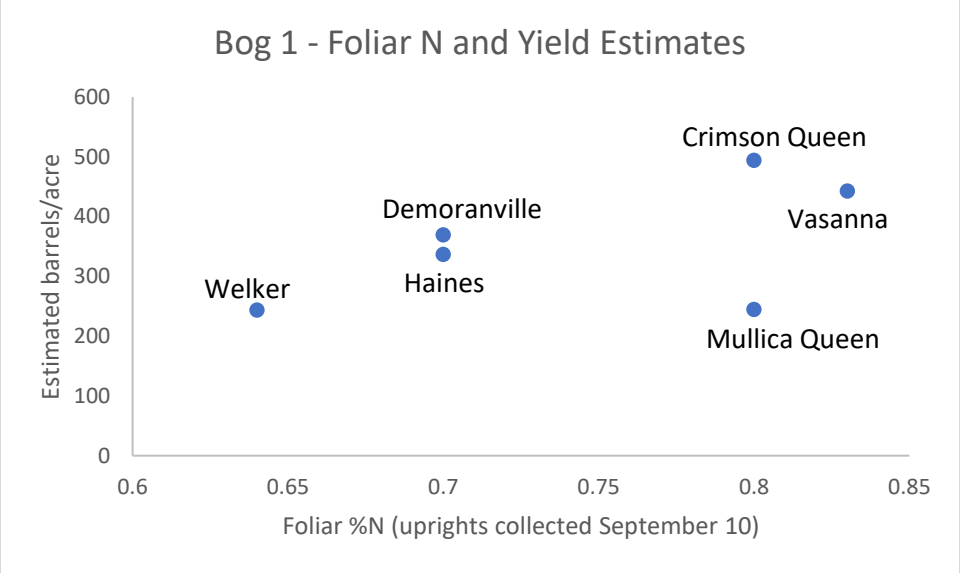

Figure 4. Relationships between foliar %N from uprights collected on September 10 and estimated average yield based on square foot berry samples (average of 3) harvested on September 22, 2020.

Work to be completed:

- Summarize Objectives 1 and 2 for certain varieties in Bog 2, including Valley Corp varieties
- Summarize Objective 3 for all varieties in Bog 2 – for 2015 and 2016 plantings from Rutgers provide information on the top 3 varieties (based on 2018 to 2020 data for 2015 plantings and 2019 to 2020 data for 2016 plantings)
- Summarize Objective 4 for certain varieties in Bog 1 and 2
- Finalize the beta-test of the cranberry data retrieval web tool
- Recommend priorities for next 3 years – focus on vine management and continued phenology observations.

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