BC Cranberry Research and Demonstration Farm

2009 - 2015 REPORT

Cover image by Keith Dobie

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Early Days & Preparation

To fulfill a vision of the directors of the BC Cranberry Marketing Commission, then Chair John Savage, lead discussions with the provincial government to have a parcel of land assigned to the cranberry industry as part of the "Gateway" project. The Gateway project involved a new highway through Delta to the Delta Port.

At the 2009 Field Day held at Darsh Banns and Family's cranberry farm, an announcement was made by the Agriculture Minister Steve Thomson, that the provincial government had agreed in principle that a parcel of land would be reserved for a cranberry research and demonstration farm. Officials in the BC Ministry of Agriculture were very supportive and helpful in securing a parcel of land.

Along with Chair John Savage, BC Cranberry Marketing Commission directors Allen May, Jeff Hamilton, Todd May and Jack Brown and Manager Jack Wessel, made progress towards the establishment of the Research and Demonstration Farm. Ralph May, legal counsel, worked closely with, and assisted, the Commission to establish the legal structure to hold the land and operate the Farm.

On September 10, 2010, a new organization, the BC Cranberry Research Society was incorporated under the BC Society Act. The Society included Chair, Todd May and Directors Grant Keefer, Allen May, John Savage, Jeff Hamilton and Jack Brown.

Directors' objective for the Farm was to strengthen the relative competitive position of BC cranberry growers. To achieve these goals, factors limiting productivity were to be determined, practices for the control of weeds and pests were to be looked at and the new varieties were to be tested.

Arrangements with the BC Ministry of Highways and Transportation allowed for the building of an access road to the site. An irrigation canal was constructed along the property's south perimeter to provide irrigation water for the Farm.

Road and Irrigation Ditch Construction

From a then wooded site in 2011, the BC Cranberry Research and Demonstration Farm now exists with five main cranberry fields, interior and perimeter drainage dykes, installed irrigation and drainage systems. A drainage sump pump was installed to connect to the farm drainage. This infrastructure facilitates drainage water containment, recirculation capacity and farm irrigation. Irrigation laterals with turn on/off taps were installed for selective irrigation purposes.

A 3500 square foot steel storage building was constructed.

On September 19, 2012 a “sneak peek” of the Farm was held.

2013

Plantings Begin

Field One plantings began in June 2013. Four recently released Rutgers varieties were planted, four Rutgers varieties in development were planted and two additional varieties were planted from other breeding programs (Washington State and Grygleski varieties) (Map 1).

A two foot buffer was maintained between bordering plots. The intent of the plantings was to allow for the evaluation of individual varieties in a larger format. The variety blocks were planted in a row from south to north on the west side of Field One. Transplants were planted by hand and spaced one foot in the row and one foot between the rows.

Other cranberry varieties were planted in the remaining east side blocks of Field One from south to north, respectively.

The last large plot of Field One consisted of baled vine cuttings/ prunings. Baled vines were distributed over the block and pressed in with a motorized walk-behind cranberry vine press.

North

Willipa Red 09/15/2013	BG 6/26/2013
CNJ99-52-69 6/17/2013	Scarlet Knight 6/29/2013
Welker 6/16/2013	Demoranville 6/28/2013
Haines 6/15/2013	Mullica Queen 6/27/2013
CNJ99-9-25 6/14/2013	Crimson Queen 6/25/2013

Map 1. Field 1 at BC Cranberry Research Farm
Dates within each cell indicate the planting date.

Field Two

The test varieties grown at Rutgers University under the supervision of Dr. Nick Vorsa, were shipped to the Research Farm in the spring of 2013. The cranberry plants, 4 to 8 inches in length, were established from rooted stolon segments in an artificial peat/perlite medium that were established in a greenhouse and were given a phytosanitary certificate by the NJ Department of Agriculture. Dr. Vorsa was able to attend and supervise the planting of the cranberry plugs in June 2013.

The June planting trials in Field Two consisted of twenty varieties, fifteen advanced selections and five standard cultivars. There were two replicate plots, 15' x 20', per variety planted in a complete randomized block design giving a total of forty plots for the trial. Each plot was established with approximately 288 plants at a one plant/ft^2 spacing.

The standard varieties included Stevens, Crimson Queen, Demoranville, Mullica Queen, and Scarlet Knight. The fifteen advanced selections represented the most promising 'elite' selections in the Rutgers/New Jersey Agricultural Experiment Station cranberry breeding program from a diversity of genetic backgrounds. Four selections represented third generation breeding and selection cycle hybrids. (Map 2).

In September 2013, six additional varieties of two replications each were hand planted into small plots in Field Two. These were from the Valley Corp. breeding program in Wisconsin and were developed by Ed Grygleski.

	6.5′					15′	6.5′
11				Valley Corp. 4	Valley Corp. 6	Valley Corp. 5	
10		Valley Corp. 1	Valley Corp. 3	Valley Corp. 2	Valley Corp. 4 & 5	Valley Corp. 4	
9		Valley Corp. 6	Valley Corp. 5	Valley Corp. 1	Valley Corp. 3	Valley Corp. 2	
8		Stevens	NJS95-37	CNJ99-52-69	Scarlet Knight	NJS98-71	20′
7		CNJ99-52-15	Demoranville	NJS98-11	CNJ93-20-155	NJS98-18	
6		NJS98-21	CNJ93-21-309	CNJ93-21-170	NJS99-4	Mullica Queen	
5		Crimson Queen	CNJ96-46-14	CNJ96-44-83	CNJ99-9-96	CNJ99-9-25	
4		NJS98-11	NJS98-18	NJS98-21	NJS98-71	NJS99-4	
3		NJS95-37	Mullica Queen	Crimson Queen	Stevens	Demoranville	
2		Scarlet Knight	CNJ99-9-96	CNJ99-9-25	CNJ99-52-15	CNJ99-52-69	
Row 1		CNJ93-20-155	CNJ93-21-170	CNJ93-21-309	CNJ96-46-14	CNJ96-44-83	
		Col 1	2	3	4	5	

Planted 09/15/2013

Planted 06/14/2013

Planted 06/13/2013

Map 2. Field 2 at BC Cranberry Research Farm. Planting dates are indicated by shading.

2014

Progress Continues

At the beginning of 2014, Dr. Kim Patten, Washington State University, was asked to be the Principle Scientific Director for the Farm. The Society was receiving Kim's input from the start, but this position allowed us to ensure that we have the continuity and practical research being performed that would benefit the cranberry growers and industry. Dr. Renee Prasad with E.S. Cropconsult and now with the University of the Fraser Valley worked with Kim to provide the technical assistance at the Farm and ensured that the scientific ground work was completed.

Field Planting

Field 1: In April 2014, BG's (plug plants - not vine cuttings or prunings) were planted to fill in the remainder of space in Field One.

Field 3: Selection for Field Three was a split bed of Demoranville and Mullica Queen. The Demoranville vine was planted on the west side of Field Three on June 29th. The Mullica Queen vine was planted on the east side of Field 3 on June 30th.

Field 4: Consultations with growers and agricultural scientists determined that a good representation of the prime BC cultivar, Stevens, would be the choice for Field Four. The Stevens vine was planted on July 2nd.

Production, Monitoring and Vine Growth

The primary objective of the first field season at the Research and Demonstration Farm was to monitor the growth and establishment of variety trials in Fields One and Two. Data collection focussed on insect and disease occurrence, percent cover of plots, crop phenology (e.g. date of first flower) and berry characteristics. With direction from Dr. Patten, Dr. Prasad diligently monitored these objectives in Field One and the Rutgers (NJ) and Valley Corp. (Wisconsin) varietal selections in Field Two.

To achieve these objectives regular site visits were made to the Farm throughout the 2014 growing season.

Findings

General observations

In both Field 1 and 2 crop coverage of plots ranged between 70 to 90% by the end of September, 2014. The few disease patches observed in some plots, in both fields, have been identified as Colletotrichum spp., Pestalotiopsis spp., Phyllosticta spp., Allantophomopsis spp., and Phomopsis spp. all of which are potential cranberry pathogens and manageable. These diagnoses were confirmed by the BC Ministry of Agriculture Plant Diagnostic Lab. Insect issues were minimal in 2014, and no management was done for insect pests this field season – most commercial fields do not begin insect protection until two or three years after planting.

The insects observed were consistent with cranberry production in the Fraser Valley: blackheaded fireworm and cranberry tipworm were the main pests. We did not observe any evidence of black vine weevil or cranberry girdler activity. Moths in the same family (Pyralidae) were observed in Field 4 and Field 2, in late September. These are unlikely to be cranberry girdler (adult flight occurs in July) however specimens were collected to obtain identification. Results of soil fertility testing (soil samples collected September 22) are summarized in Table 4 below.

Table 4. Soil fertility status of Fields 1, 2 and 4 (September 22, 2014 collection)

Bog	pH	Est. E.C. Mmhos cm	O.M. %	Total N%	C/N	Bray Avail P ppm	Avail K ppm	Avail Ca ppm	Avail Mg ppm	Avail Na ppm	Avail Cu ppm	Avail Zn ppm	Avail Fe ppm	Avail Mn ppm	Avail B ppm
1	3.7	0.50	95.4	1.08	44.2	25	280	1100	990	230	1.4	13	80	19	1.5
2	3.9	0.54	92.4	1.01	45.7	17	210	1400	1250	220	1.7	9.4	70	24	0.7
4	3.6	0.82	96.4	1.11	43.4	12	160	800	850	270	1.0	7.4	80	12	0.2

Field 1. Summary of Observations

We observed tipworm and red leaf spot throughout Field 1, however the severity of the two pests varied across plots (Table 5). Dead runners and distorted leaves and upright tips were observed in three plots on June 30. Vines and uprights from these plots were submitted to the BCAgri Plant Diagnostic lab and the pathogens Colletotrichum acutatum (the bitter rot pathogen) and Allantophomopsis sp. (associated with leaf spot) were cultured from the samples.

Berries were collected on Aug. 19, September 21 and October 9 (Fig. 1, Fig. 2, and Table 6). On August 19 the biggest berries were from the Crimson Queen and CNJ99-9-25 plots and the smallest from Scarlet Knight and Willipa Red (Fig. 1). A subjective evaluation of the uniformity of berries from each plot was also made by four individuals – berries were assessed on uniformity of berry shape, size and colour on August 19.

CNJ99-52-69, CNJ99-9-25, Crimson Queen, Mullica Queen and Demoranville were considered to have fairly uniform berries (of the 50 berries harvested August 19). Of the five, CNJ99-52-69 had the most uniform berries. Table 7 summarizes the macro and micronutrient levels of the cranberry foliage in Field 1.

Table 5. Summary of pest and crop development observations in Field 1 on July 15. Observations are based on both dates unless otherwise noted.

	Red leaf spot severity[1]	Tipworm[2]	Berry Reddening (July 15) (Presence/Absence)	Damaged berries (July 15)	Brown/Dead uprights or runners[3] (August 19)
Crimson Queen	1	1	Present	Present (sun scald mostly)	0
CNJ99-52-15	1	1	Present	Not observed	1
Mullica Queen	1	2	Present (deeper red than other plots)	Present (mainly shrivelled)	1
CNJ99-52-69	1	1		Not observed	0
Demoranville	1	1-2 (depending on location)	Present	Present (sun scald mostly)	0
CNJ99-9-96	1	2-3 (depending on location)	Absent	Not observed	1
Scarlet Knight	0	0-1 (depending on location)	Absent	Not observed	1
CNJ99-9-25	1	1	Absent	Not observed	0
BG	1	1-2 (depending on location	0	Not observed	0
Willipa Red	0	1	Absent (few berries overall)	Not observed	

1. Red Leaf Spot rankings as follows: 0 = no symptoms observed; 1 < 10% of uprights with symptoms, 2 = 11-25% with symptoms; 3 = 26 to 50% with symptoms; 4 = 50% or more with symptoms
2. Tipworm rankings as follows: 0 = no cupping observed; 1 < 10% of uprights with cupping, 2 = 11-25% of uprights with cupping; 3 = 26 to 50% of uprights with cupping; 4 = 50% of uprights with cupping
3. Brown/dead upright or runner rankings as follows: 0 = no brown or dead uprights/runners; 1 < 10% of uprights/runners brown or dead, 2 = 11-25% of uprights/runners brown or dead; 3 = 26 to 50% of uprights/runners brown or dead; 4 = 50% of uprights/runners brown or dead

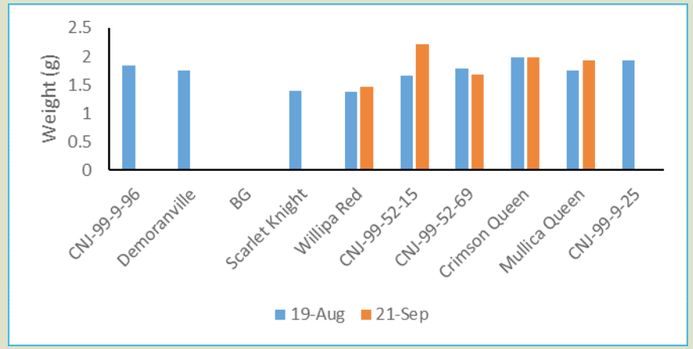


Figure 1. Weight of individual cranberries (based on 50 berries collected/plot) collected from Field 1 on August 19 and September 21, 2014.

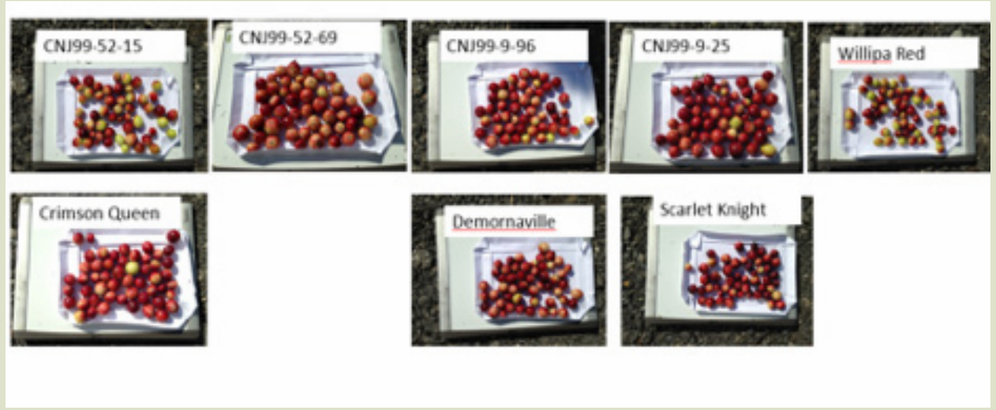


Figure 2. Field 1 berries collected and photographed on August 19, 2014.

Berries from the Mullica Queen plot were weighed on the 19th but photograph is missing.
No berries were harvested from the BG plots.

Table 6. Field 1 berry characteristics based on Ocean Spray Canada parameters for ABS, TACY and Brix. (Data courtesy of Ocean Spray Canada, Richmond, BC).

	ABS (Sept 21)	ABS (Oct 9)	TACY (Sept 21)	TACY (Oct 9)	Brix (Sept 21	Brix (Oct 9)
Crimson Queen	0.479	0.696	56	81	9.20	9.97
CNJ99-52-15	0.42	0.774	50	90	10.05	10.19
Mullica Queen	0.446	0.679	52	79	9.97	10.36
CNJ99-52-69	Not enough sample	0.766	Not enough sample	89	Not enough sample	10.60
Demoranville	Sampling error	0.84	Sampling error	98	Sampling error	11.53
CNJ99-9-96	Sampling error	0.636	Sampling error	74	Sampling error	No data
Scarlet Knight	Sampling error	1.245	Sampling error	145	Sampling error	10.01
CNJ99-9-25	Sampling error	0.803	Sampling error	94	Sampling error	11.04
BG	Not berries	No berries	Not berries	No berries	Not berries	No berries
Willipa Red	Not enough sample	No berries	Not enough sample	No berries	Not enough sample	No berries

Table 7a. Foliar macronutrients for plots in Field 1. Uprights were collected on September 21, 2014 (Data courtesy of PSAI Inc., Richmond BC)

	Nitrogen %	Phosphorus %	Calcium %	Magnesium %	Potassium %
Crimson Queen	1.09	0.10	1.40	0.25	0.43
CNJ99-52-15	0.85	0.11	1.28	0.19	0.38
Mullica Queen	0.91	0.09	0.98	0.21	0.31
CNJ99-52-69	0.85	0.10	1.28	0.23	0.34
Demoranville/ Scarlet Knight	0.97	0.11	1.39	0.21	0.38
CNJ99-9-96/ CNJ99-9-25	0.83	0.11	1.24	0.18	0.40
BG	1.09	0.13	0.82	0.19	0.37
Willipa Red	1.00	0.13	0.92	0.18	0.47

Table 7b. Foliar micronutrients for plots in Field 1. Uprights were collected on September 21, 2014 (Data courtesy of PSAI Inc., Richmond BC)

	Copper (ppm)	Zinc (ppm)	Iron (ppm)	Manganese (ppm)	Boron (ppm)
Crimson Queen	5	34	88	476	53
CNJ99-52-15	4	26	103	164	40
Mullica Queen	4	36	103	170	48
CNJ99-52-69	5	35	87	195	41
Demoranville/ Scarlet Knight	5	61	93	252	43
CNJ99-9-96/ CNJ99-9-25	4	29	83	134	39
BG	3	25	77	322	39
Willipa Red	4	26	72	272	29

Field 2. Summary of Observations

Crop and berry development observations are summarized in Table 8. Some particular observations on growth and development of vines and berries include the following:

1. Earliest flowering varieties (based on flowers or hooks in plot centres on May 27 – first observation day that flowers were observed)
   - Demoranville
   - Mullica Queen
   - CNJ93-21-309
   - CNJ99-9-25
   - NJS98-18
   - NJS99-4

An additional observation on flower set was that on June 17 we observed that both plots of NJ98-11 had the most blooms out of all the plots in Field 2.

2. Varieties with no berries observed (in one or both plots):
   - CNJ96-46-14
   - NJS98-71
   - Stevens

3. Varieties with 50%+ bud set, in one or both plots, by August 19
    - Demoranville
    - Mullica Queen
    - Scarlet Knight
    - CNJ93-20-155
    - CNJ96-46-14
    - CNJ99-9-25
    - CNJ99-9-96
    - NJS95-37
    - NJS98-11
    - NJS98-71
    - NJS99-4

4. Varieties with the highest numbers of ripe berries by August 26 were
    - Crimson Queen (83%)
    - Demoranville (78%)
    - CNJ93-21-309, CNJ96-44-83, CNJ99-9-25 (55%)

5. Varieties with the heaviest berries (on average and based on a very small number of berries across both replicates) were
    - NJS98-11 (2.45g/berry)
    - NJS99-4 (2.35g/berry)
    - Crimson Queen (2.33g/berry)

Observations on diseases (red leaf spot, rose bloom, berry rots), insects (tipworm) and other symptoms of abnormal growth (dead or brown uprights or runners and overgrowth) are summarized in Table 9. Some particular observations include the following:

1. 60 berries were collected from across the farm with symptoms of berry rot or bruising and submitted to the Ministry Plant Health Lab on September 26. 2/60 had Pestalotiopsis sp. and 1/60 had Colletotrichum sp. No other pathogens were isolated from the remaining 57 berries. Additionally, observed berry rot or bruising in the following varieties during the August 26 harvest
    - Crimson Queen
    - CNJ99-9-25
    - CNJ96-44-83
    - Mullica Queen

2. By August 19 we observed tipworm in almost all plots in Field 2. The overall infestation level in Field 2 did not exceed 15% (of approximately 100 uprights in the plot centres with obvious cupping of tips). Tipworm was first observed in the two Demoranville plots on May 13. No tipworm was observed in either of the CNJ99-9-25 plots (Table 9).

3. Overall the amount of dead or dying uprights and runners was very low. For our assessment of dead runners and uprights on August 19 we ruled out any mechanical causes of the damage by following runners back to plugs and observing for signs of physical injury (shovel or rodent feeding). Samples of uprights and runners with a mixture of dead/dying and healthy material were submitted to the BC Agri Plant Lab for diagnosis. Four organisms were identified: Phomopsis sp. (associated with upright dieback), Colletotrichum sp. (associated with bitter rot) and very low levels of Phyllosticta sp. and Pestalotiopsis sp. Based on our 2014 assessments we did not observe any pattern among varieties to suggest that some varieties are more susceptible to these symptoms than others.

4. We did not observe red leaf spot in either plot of the following varieties
    - CNJ93-21-170
    - CNJ93-21-309
    - CNJ96-46-14

5. Rosebloom was only observed in a few plots
    - CNJ99-9-25 (Rep 1)
    - Stevens (Rep 1)
    - CNJ99-9-96 (Rep 2)
    - Crimson Queen (Rep 2)
    - NJS98-18 (Rep 2)

Table 8. Crop and berry development for cranberry varieties planted in Field 2.

	Earliest date flowers or hooks observed	Reddening berries on July 8 (Presence/ Absence)	Bud set on August 19[2] Rep1/Rep2	Ripe berries on August 26[3] #ripe/total berries (%)	Weight/berry (grams)
Crimson Queen	June 3	Present	3/3	10/12 (83%)	2.33g
Demoranville	May 27 (Rep 2)	Absent	1/4	14/18 (78%)	1.94g
Mullica Queen	May 27 (Rep 2)	Present (Rep 2)	2/4	3/20 (1.5%)	2.25g
Scarlet Knight	June 3 (Rep 2)	Present (Rep 2)	4/2	4/11 (36%)	1.81g
Stevens	June 11 (Rep1)	No berries	1/4	Only 1 berry	n/a
CNJ93-20-155	June 3	Present	4/3	9/20 (45%)	2.30g
CNJ93-21-170	June 3 (Rep 1)	Present	1/3	8/20 (40%)	1.65g
CNJ93-21-309	May 27	Absent	1/2	11/20 (55%)	2.30g
CNJ96-44-83	June 11 (Rep 2)	Present (Rep 2)	2/1	6/11(55%)	2.08g
CNJ96-46-14	June 11 (Rep 1)	Absent	3/4	No Berries	n/a
CNJ99-52-15	June 3	Absent	3/3	4/20 (20%)	2.15g
CNJ99-52-69	June 11	Present (Rep 2)	3/3	6/12 (50%)	1.67g
CNJ99-9-25	May 27 (Rep 2)	Present	4/2	11/20 (55%)	2.00g
CNJ99-9-96	June 3 (Rep 1)	Present (Rep 1)	3/4	2/20 (10%)	2.00g
NJS95-37	June 3	Present (Rep 1)	4/4	1/20 (5%)	1.65g
NJS98-11	June 3	Present (Rep 1)	4/3	9/20 (45%)	2.45g
NJS98-18	May 27 (Rep 1)	Present	2/1	9/20 (45%)	1.95g
NJS98-21	June 3 (Rep 2)	Present (Rep 2)	2/3	2/7 (29%)	1.57g
NJS98-71		No berries	1/4	Only 1 berry	n/a
NJS99-4	May 27 (Rep 2)	Present	4/4	9/20 (45%)	2.35g

1. Bud set rankings as follows: 0 = no bud set observed; 1 < 10% of uprights with buds, 2 = 11-25% with bud set; 3 = 26 to 50% with bud set; 4 = 50% or more with bud set
2. Berry ripeness was based on the brownness of seeds inside the berry. All seeds had to be brown for a berry to be considered ripe.
3. Total berries based on berries from both plots. We collected 10 berries/plot or if fewer than 10 berries were found then all the berries that could be found after 5 minutes of searching the entire plot.

Table 9. Summary of disease, insect and abnormal observations of plant appearance for cranberry varieties planted in Field 2.

	Frost damage (April 27)[1] Rep1/Rep2	Red Leaf Spot Presence (June 17 and July 8)[2] Rep1/Rep2	Overgrowth rating (August 19)[3] Rep1/Rep2	Tipworm Rating (August 19)[4] Rep1/Rep2	Brown or dead uprights or runners (August 19)[5] Rep1/Rep2
Crimson Queen	2/2	0/0	1/3	1/1	2/1
Demoranville	1/1	1/1	1/0	2/2	1/0
Mullica Queen	2/2	2/0	4/1	1/0	1/0
Scarlet Knight	2/2	3/2	3/1	1/1	0/0
Stevens	2/2	2/2	4/2	1/2	0/0
CNJ93-20-155	2/2	2/0	4/4	2/0	1/1
CNJ93-21-170	2/2	0/0	4/0	1/1	0/0
CNJ93-21-309	2/4	0/0	3/4	1/1	0/0
CNJ96-44-83	1/4	0/2	1/0	1/1	2/0
CNJ96-46-14	2/2	0/0	4/4	1/1	0/0
CNJ99-52-15	2/3	3/1	0/0	1/1	2/1
CNJ99-52-69	1/2	3/4	2/2	1/1	1/1
CNJ99-9-25	2/1	2/3	1/4	0/0	0/1
CNJ99-9-96	4/2	2/2	3/1	2/1	0/0
NJS95-37	2/2	2/2	0/2	1/1	0/0
NJS98-11	2/2	1/2	2/1	2/1	0/0
NJS98-18	3/2	1/2	3/0	2/1	0/1
NJS98-21	2/3	3/2	2/0	1/1	0/0
NJS98-71	2/4	3/3	2/1	1/1	0/0
NJS99-4	3/2	0/3	1/0	1/1	1/2

1. Frost damage rankings are as follows: 0 = no symptoms observed; 1 < 10% of uprights with symptoms, 2 = 11-25% of uprights with symptoms; 3 = 26 to 50% of uprights with symptoms; 4 = 50% or more uprights with symptoms
2. Red Leaf Spot rankings as follows: 0 = no symptoms observed; 1 < 10% of uprights with symptoms, 2 = 11-25% with symptoms; 3 = 26 to 50% with symptoms; 4 = 50% or more with symptoms
3. Overgrowth rankings as follows: 0 = no runners observed on top of plot; 1 < 10% of plot surface covered with runners, 2 = 11-25% of plot surface covered with runners; 3 = 26 to 50% of plot surface covered with runners; 4 = 50% of plot surface covered with runners
4. Tipworm rankings as follows: 0 = no cupping observed; 1 < 10% of uprights with cupping, 2 = 11-25% of uprights with cupping; 3 = 26 to 50% of uprights with cupping; 4 = 50% of uprights with cupping
5. Brown/dead upright or runner rankings as follows: 0 = no brown or dead uprights/runners; 1 < 10% of uprights/runners brown or dead, 2 = 11-25% of uprights/runners brown or dead; 3 = 26 to 50% of uprights/runners brown or dead; 4 = 50% of uprights/runners brown or dead

Official Opening

September 5th, 2014, the official opening of the BC Cranberry Research and Demonstration Farm took place. The weather was perfect and a good crowd was out for the event. Growers and others were able to tour the Farm and find out what varieties were being grown.

On hand to explain the progress of the Farm were Todd May and Grant Keefer, with the BC Cranberry Research Society, Dr. Nick Vorsa, Rutgers University and Dr. Kim Patten the Farm's Scientific Director. For more information about the Opening, videos are posted on the Commission's website.

2015

Trial Results

Field Planting

Field 2

The April 10, 2015 planting represented five selections from the Valley Corp. breeding program (planting material from 2014).

Field 2

The May 22, 2015 planting represented seventeen advanced ‘selections’ from the most recent breeding and selection cycles of the Rutgers cranberry breeding program. The ‘selections’ were originally selected from the progenies grown at the Rutgers PE Marucci Center, NJAES, Chatsworth, NJ. Selection criteria included:

- Yield potential
- Yield stability
- Season of maturity
- Fruit quality
- Tacy (total anthocyanin content)

Selections also represented novel genetic ancestry. Trial included five standards: Stevens, Mullica Queen, Scarlet Knight, Haines and Walker. Each selection and standard had two replicate plots planted in a randomized-block-design (44 - 15 ft x 10 ft plots). Each plot was planted with 147 rooted cuttings.

Production Monitoring

This second field season at the research farm was to continue to make observations and collect data on phenology and development of varieties. We also did our first harvest assessments in Fields 1 and 2 this year and much of the activity was centered on the harvest assessments (July, August, September and October).

Activities: To achieve these objectives regular site visits were made to the research farm throughout the 2015 growing season (Table 10 and 11). Weekly site visits were also made for pest management monitoring.

Table 10. Summary of activities in Field 1

Date	Type of Activities	Specific information collected
April 13	Data collection	Phenology – bud development
April 24	Data collection	Phenology – bud development
April 30	Data collection	Phenology – bud development
May 12	Data collection	Phenology – bud development
May 22	Data collection	% Bloom
June 8	Data collection	% Bloom
June 23	Data collection Fungicide Spray Trial	% Bloom Comparison of Proline, Quadris as follow up sprays for first fungicide application (Quadris field wide)
July 22	Data and Berry collection	Pre-harvest assessment
August 22	Data and Berry collection	Pre-harvest assessment % Runners
September 22	Berry Collection	Pre-harvest assessment
October 6	Berry collection	Fungicide and Nutrient trials

Table 11. Summary of activities in Field 2.

Date	Type of Activities	Specific information collected
March 27	Data collection	Crop phenology
April 19	Data collection	Crop phenology
April 29	Data collection	Crop phenology
May 12	Data collection	Crop phenology
May 22	Data collection, planting	% bloom and fireworm activity
June 2	Data collection	% bloom
June 5	Data collection	% bloom + tipworm activity
June 24	Data collection	Crop phenology
July 5	Data collection	Berry ripening
July 12	Data collection	Berry ripening
August 5	Data collection	Berry ripening and damage
August 8	Data collection	% overgrowth
September 29	Berry collection	Yield assessment

General Methodology Development

Bloom and Out-of-Bloom Calculations

Bloom was determined for 10 random flowering uprights that were checked along a transect running through the middle of each plot. We calculated % bloom using the following formula

% Bloom =

Total # of flowers	x 100%
Total # flowers and unopened flower pods	

% Out-of-bloom was determined in for 10 random flowering/fruiting uprights that were checked along a transect running through the middle of each plot. We used the following formula to determine % out-of-bloom:

% Out-of-bloom =	Total # of pinheads & berries	x 100%
	Total # of pinheads, berries, flowers and unopened flower pods	

Standard Operating Procedure Development

An important goal of Year 2 and 3 was to document all data collection activities into a Standard Operating Procedure (S.O.P.) manual so that data are be collected in a similar manner in subsequent years. Additionally changes in methodology can be tracked. In 2015, the focus was on harvest assessment and the following protocols were developed for yield assessment and berry quality

A. Yield Assessment S.O.P.

1. Collect fruit from 1 foot square – using quadrant with solid sides and legs
2. Collect ALL fruit from 1 foot square into labelled PAPER bag, i.e. ensure you collect right down to soil level and not just surface fruit.
3. Collect from 3 spots in Field 1 (for first collection toss a ring into the plot from the pathway. Work between the North and South sprinklers of each plot and at least 3 m from East and West edges. This will mark the 3 random spots for first collection and the approximate sites for the subsequent collections). Collect from 2 spots in Field 2 – placing square randomly in the centre of each plot (1 m from edges). Flag the centre point of each collection area so that subsequent collections do not overlap
4. If berries are not to be assessed the same day then place in Fridge. Ideally berries are collected in the early morning (before 10 am) and placed in fridge/ shade within one hour of collection. This is especially important for the final assessment when fruit rot at harvest and post harvest is also assessed. Avoid having picked berries sitting in the sun in the paper bags. Take out a cooler with ice packs to get berries cooled more quickly.
5. Pour and shake berries through screens set up from largest to smallest. There should be 2 screen sizes: #3 – ½"(13mm), and minimum size – 9/32". Anything smaller than the minimum size is undersize. For undersize discard obviously dead pinheads. (NB: additional screen sizes ¾" (19mm) and 5/8" (16mm) correspond to SDC #1 and #2 – and these can be used in the future).
6. Before counting ensure that you have a single layer of fruit in the screen bottom – otherwise you will overestimate one size category and underestimate another. Additionally because the edges of the screens are only partial squares smaller fruit can be caught up along edges. So care must be taken at this step. If there is more fruit than a single layer then put the excess fruit back in the bag for a second measurement
7. Before doing final counts tap screen with the lower screen(s) still fitted. Remove any rotting berries (to a rotting container so you can count and weigh them as a total/bag). Then count. Then weigh (to two decimal places). Then move on to next screen repeating the steps in #6.
8. Before discarding fruit ensure that no further analyses are needed - e.g. Brix, Tacy, ABS, keeping quality. Fruit can be frozen for the Brix, Tacy, ABS - freeze 500 g (l lb) of fruit/collection bag.

B. Fruit Quality S.O.P.

Purpose: To determine fruit quality in response to harvest practices (beating and delayed harvest post-flooding)

Timing: After the initial flooding and beating but before berries begin to float away from vines.

Supplies: Metal colanders, plastic buckets, plastic bags, laboratory scale (weighs in grams to two decimal places).

1. Place colander in field below water surface and fill with berries. Try to minimize large debris.
2. Raise colander to drain water and determine if more berries are needed. Fill colander to a level layer even with the rim. Do not heap cranberries above rim.
3. Place cranberries in a plastic bucket that is pre-labelled. Rain paper is the best as it can be placed right into the bucket. (Fig. 3a)
4. Collect from at least two areas/plot.
5. Buckets should be filled with water so that berries are standing in water. Buckets are placed inside the farm building out of direct sunlight. (Fig. 3b)
6. Assess fruit rot by collecting a 125 mL sample of berries from the bucket at regular intervals for at least one week and no more than two weeks.
7. Record the total number of berries in the 125 mL sample and the number of berries with rot.

Figure 3. A (Top Left) – Cranberries collected from field are placed in a metal colander, water is drained out and cranberries are filled to rim level. B (Bottom Left) – One colander of cranberries is placed in a bucket with water proof paper. C (Right) – Cranberries are then held in the farm building out of direct sunlight for at least seven days to observe degradation of fruit quality in water.

Pest Management

A weekly pest monitoring program was run for the first time at the research farm, in 2015. Levels of the key pest of cranberries, blackheaded fireworm (Rhopobata naevana) were high, as expected for previously unmanaged fields. Spray timings were based on visual observation for fireworm larvae. In addition to fireworm, cranberry fruitworm (Acrobasis vaccinii) was also observed at the research farm. Cranberry fruitworm levels were relatively higher and earlier at the research farm than at surrounding farms. Again this is to be expected given that the fields were unmanaged previously. Insecticide applications were based on pheromone trap and fruit assessments as per the recommended protocol (T. Heuppelsheuser, BC Ministry of Agriculture, personal communication, June 2015). Cranberry tipworm (Dasineura oxycoccana) was also present in both Fields 1 and 2, at levels in excess of the 30% infested uprights threshold that is currently used by some BC growers.

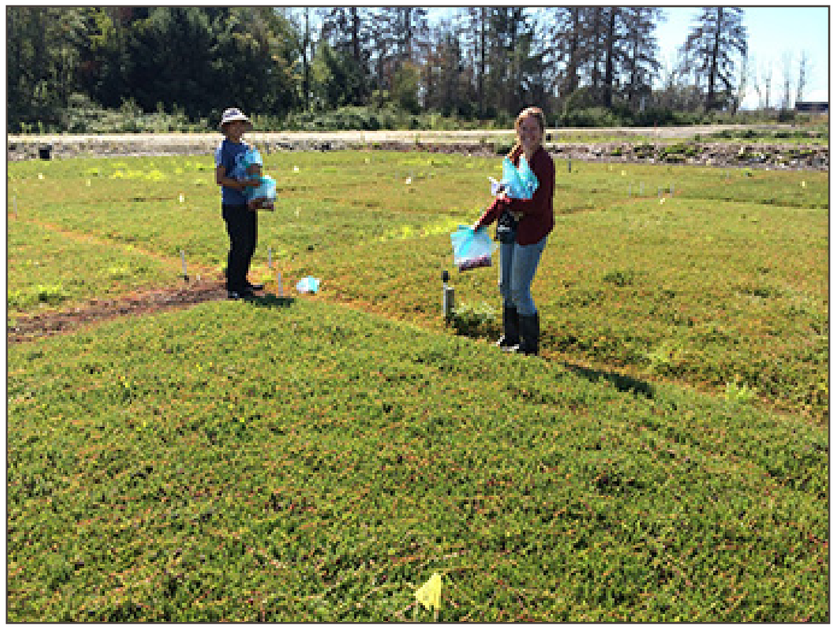
A small amount of black vine weevil (Otiorynchus sulcatus) notching was observed and cranberry girdler (Chrysoteuchia topiaria) moths were caught in pheromone traps, however no treatments were made for either of these pests. Post-bloom applications of Movento were applied to reduce the tipworm population. Fungicide applications for reducing the incidence of fruit rot were also done for Field 1, based on crop phenology (majority of the field at 50% out of bloom stage).

Assessment

Nutrient management: As in 2014, soil was collected to assess fertility and guide management in 2015. We collected soil on September 3 from all four planted fields (Table 12).

Table 12. Soil fertility status of Fields 1, 2, 3 and 4 (September 3, 2015 collection)

Field	pH	Est. E.C. Mmhos cm	O.M. %	Total N%	C/N	Bray Avail P ppm	Avail K ppm	Avail Ca ppm	Avail Mg ppm	Avail Na ppm	Avail Cu ppm	Avail Zn ppm	Avail Fe ppm	Avail Mn ppm	Avail B ppm
1	3.5	0.43	96.0	0.96	50.0	13	213	1250	1100	250	1.1	6.3	75	4.3	0.7
2	3.4	0.37	87.0	0.96	45.3	16	213	1250	1088	188	3.5	7.3	78	8.3	1.2
3	3.5	0.39	93.0	0.98	47.4	11	213	1000	913	225	1.0	7.1	60	5.5	1.2
4	3.3	0.51	92.0	1.05	43.8	10	175	1000	925	213	1.0	5.9	58	7.5	0.7



Field 1. Summary of Observations

Uprights were well established in nine of the 10 plots this year. The youngest plot (Willipa Red) still has some bare patches, however this plot was a full year behind the remaining nine. With the well-established vegetative growth varietal differences in terms of bloom (Fig. 4) and berry load were very distinct in 2015.

Figure 4. Field 1 phenology as of June 9, 2015. Varieties from Top Left to Bottom Left: Willipa Red, CNJ99-52-69, Welker, Haines, CNJ99-9-25. Varieties from Top Right: BG, Scarlet Knight, Demoranville, Mullica Queen, Crimson Queen.

General observations on phenology that can be made based on the data (Table 13) include the following

- Crimson Queen is the earliest bloomer of the 10 varieties based on 53% out of bloom on June 8
- Haines is the latest bloomer of the 10 varieties being at 0% out of bloom on June 8

The timing for bloom and out of bloom is important for a number of management steps including bringing in pollinators; timing of fungicide sprays for fruit rot; and timing of insecticide sprays for cranberry tipworm. In 2015, Haines and Crimson Queen were almost a month apart in terms of bloom phenology.

- Haines, Welker, and the numbered variety CNJ99-9-25 had the highest estimated yields based on the August 22 and September 22 harvests (Table 13, Fig. 5)
- Although Willipa Red and BG varieties had lower yields these plots were planted on full growing season than the other plots in the field, so it is not surprising that yields are lower
- Fruit rot one month prior to harvest was below 10% for almost all varieties (Table 13)
- All fruit quality parameters for each variety were consistent with performance in other areas (Table 14)

- The protocol used to assess post harvest fruit quality made estimates of fruit rot that were much higher than September 22 assessments (Fig. 6); these values were also much higher than the fruit quality rating for the field overall. One reason for the higher rot levels in our post-harvest assessment is that the protocol concentrated collection around plot edges – so not a random sample through the middle of plots as was done for square foot assessments.
- Given the limitations of our protocol, it is still interesting that holding berries in water did not increase levels of rot for all varieties; e.g. Haines had similar levels of rot regardless of whether berries were held in water or not (Fig. 6A)
- Foliar nutrient analysis (Table 15) can help guide fertilizer inputs for each variety in 2016; in particular we are interested in which varieties may be require more inputs given the higher productivity

Field 1 received a single fruit rot spray in 2015, the timing of which may not have been appropriate for some varieties (e.g. Crimson Queen, Mullica Queen, 99-9-25, and Demoranville) but well timed for others (Haines and Welker). (See Fungicide trial results below)

Table 13. Crop development observations and yield estimates for cranberry varieties planted in Field 1.

	Elongation	Hooks on May 12	% Bloom May22	% out of bloom June 8	Estimated barrels/acre August 22	Estimated barrels/acre Sept 22	% Rot Sept 22
Crimson Queen	April 13	Yes	3%	53%	240	335	2.60%
CNJ99-9-25	April 24	Yes	12%	9%	389	473	1.21%
Mullica Queen	April 30	Yes	3%	30%	182	153	0.78%
Haines	May 12	NO	5%	0%	329	508	1.68%
Demoranville	May 12	NO	15%	11%	175	172	1.02%
Welker	May 12	NO	2%	11%	485	611	4.41%
Scarlet Knight	April 24	NO	2%	33%	102	136	1.41%
CNJ99-52-69	May 12	NO	25%	6%	206	283	2.25%
BG	May 12	Yes	28%	38%	57	116	14%
Willipa Red	May 12	Yes	29%	40%	47	65	1.60%

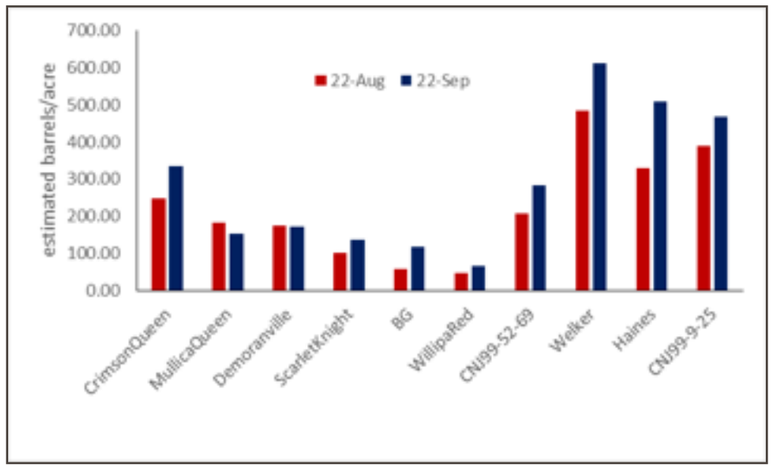
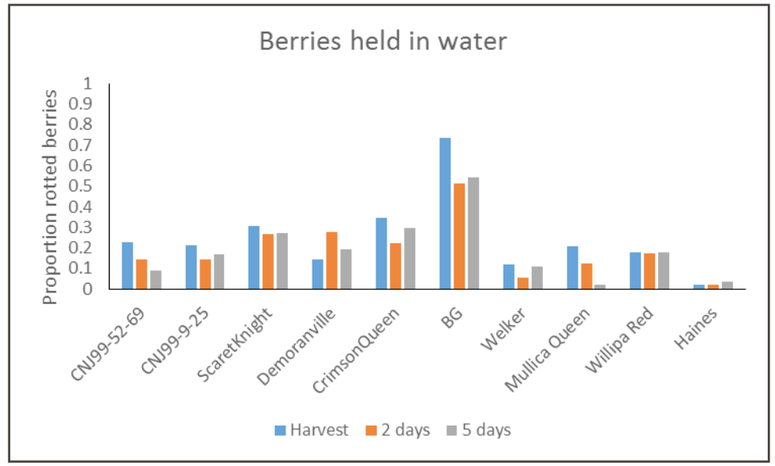


Figure 5. Field 1 yield estimates based on square foot harvests from 3 locations in each variety plot on two different dates (8 weeks and 4 weeks) prior to harvest. NB – BG and Willipa Red Varieties were planted later than the other varieties.



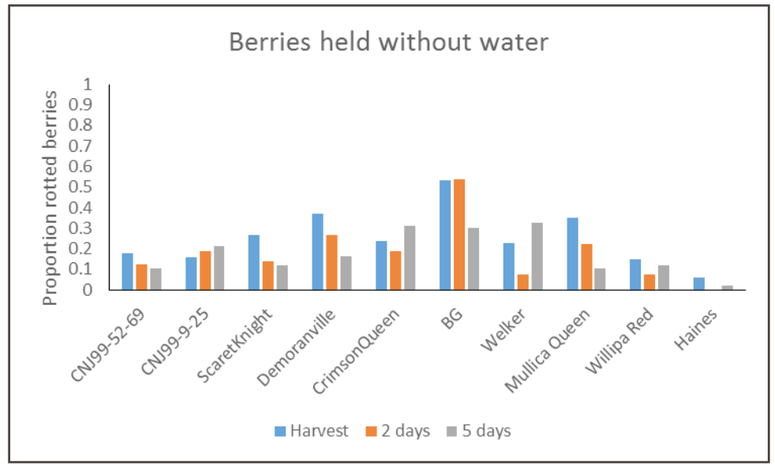


Figure 4. Progress of fruit rot in cranberries on day of harvest and after being held for two and five days after harvest either in water (upper) or without water (lower).

Table 14. Field 1 berry characteristics based on Ocean Spray Canada parameters for ABS, TACY and Brix. (Data courtesy of Ocean Spray Canada, Richmond, BC).

	ABS	BRIX	TACY	Firmness
Crimson Queen	0.430	8.67	50	767
CNJ99-9-25	0.776	9.42	90	918
Mullica Queen	0.884	10.19	103*	906
Haines	0.680	9.00	79	934
Demoranville	0.816	10.27	95	917
Welker	0.725	8.80	84	836
Scarlet Knight	1.129	10.23	132	746
CNJ99-52-69	0.800	9.86	93	811
BG	0.381	9.92	44	834
Willipa Red	0.751	10.14	87	843

*TACY results for Mullica Queen in Field 1 are not consistent with results from other plantings. In Field 2 Mullica Queen TACY values were more consistent – 54 – which is characteristics of this variety.

Table 15a. Foliar macronutrients for plots in Field 1. Uprights were collected on August 21, 2015 (Data courtesy of PSAI Inc., Richmond BC)

	Nitrogen %	Phosphorus %	Calcium %	Magnesium %	Potassium %
Crimson Queen	0.97	0.10	1.29	0.28	0.36
CNJ99-9-25	1.04	0.10	1.22	0.22	0.34
Mullica Queen	0.90	0.09	1.06	0.30	0.30
Haines	0.98	0.10	1.55	0.30	0.31
Haines (West edge)	0.88	0.10	1.68	0.28	0.29
Demoranville	0.77	0.08	1.34	0.23	0.33
Welker	0.66	0.12	1.69	0.26	0.39
Welker (West edge)	0.66	0.13	1.54	0.30	0.39
Scarlet Knight	0.82	0.10	1.33	0.29	0.30
CNJ99-52-69	0.74	0.09	1.30	0.20	0.34
BG	0.70	0.08	0.90	0.22	0.29
Willipa Red	0.45	0.08	0.87	0.19	0.43
Willipa (South)	0.62	0.09	0.77	0.17	0.42

Table 15b. Foliar micronutrients for plots in Field 1. Uprights were collected on August 21, 2015 (Data courtesy of PSAI Inc., Richmond BC)

	Copper (ppm)	Zinc (ppm)	Iron (ppm)	Manganese (ppm)	Boron (ppm)
Crimson Queen	3	30	196	227	34
CNJ99-9-25	3	23	116	186	38
Mullica Queen	3	38	125	182	55
Haines	3	41	109	229	54
Haines (West)	3	21	103	98	57
Demoranville	3	32	145	108	35
Welker	4	40	135	197	58
Welker (West)	3	31	115	224	48
Scarlet Knight	4	42	135	177	47
CNJ99-52-69	5	31	146	156	51
BG	3	23	134	171	46
Willipa Red	2	32	181	228	32
Willipa (South)	2	25	88	145	32

Fungicide Trial

Field 1 – Haines, Demoranville, Welker

While there was a trend towards lower levels of fruit rot in plots treated twice with Quadris in the Demoranville plot (Fig. 7), overall we did not observe any reduction in fruit rot incidence following the second fungicide treatments (Quadris or Proline) compared to only a single fungicide treatment (Control). The timing of fungicide treatments and the overall low levels of rot in the plots suggest that these trials may need to be conducted, either in areas of plots with higher disease pressure (e.g. areas with overgrowth and along edges close to dykes) or under conditions where disease can be introduced to plantings.

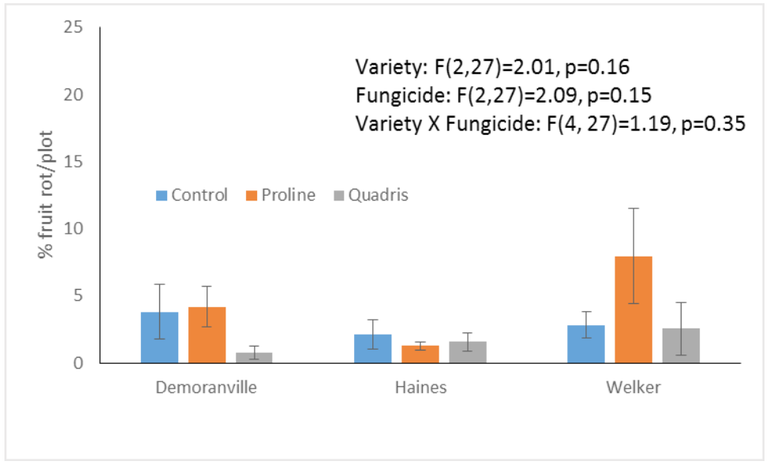


Figure 7. Effect of a fungicide applications on fruit rot incidence in three variety trial plots in Field 1. Bars indicate the mean±s.e. for 3 replicates per fungicide and variety combination (N=27).

Field 2. Summary of Observations

Observations for Field 2 include the following

- Cranberry fruitworm damage was higher for plots located on the East and West edges of the field, regardless of variety
- The earliest blooming varieties, based on presence of hooks on May 12, were: CNJ 93-21-309, 96-44-83, 93-21-170, Mullica Queen, Crimson Queen, Scarlet Knight, NJS98-11, 98-18, 98-21, 98-71, 99-4

- Several varieties were still blooming at significant levels as late as June 24: CNJ93-21-170, 99-9-96, and 99-52-15
- There was severe tipworm infestation in at least one replicate of the following varieties: CNJ93-20-155, 96-46-14, Crimson Queen, 96-44-83, 93-21-309, NJS98-11, 98-18. These observations were not related to the location of the plots (i.e. they weren't all beside each other).
- Varieties with the least amount of overgrowth on August 8 were: CNJ99-52-15, NJS98-71, Mullica Queen, and NJS98-11; for all of the plots in Field 2 overgrowth continued to develop through to September
- Yield estimates were higher for the 10 varieties that are in both Fields 1 and 2 (Table 13 and Fig. 3 compared to Table 16). The estimates for Field 1 are likely to be more accurate, since the plots are much larger. The highest yielding varieties for Field 2 were: CNJ93-20-155 and NJS98-11 with estimated yields of over 450 barrels/acre (Table 7)
- Levels of field rot were much lower in Field 2 than in Field 1, which probably reflects in part the overall lower level of disease pressure (i.e. fewer berries in unharvested berries in 2014 in Field 2 compared to Field 1). Varieties with the least amount of fruit rot 3 weeks prior to harvest were Demoranville, NJS99-4, NJS98-11, CNJ93-21-309, and Scarlet Knight with less than 2% rot (Table 7)

Table 16. Yield estimates for cranberry varieties planted in Field 2 (average of two replicates)

	% Rot September 29	Estimated yield (barrels/acre) Sept. 29	Weight/berry (grams) (marketable only)	Weight/berry (grams) 2014 data
Crimson Queen	21.04	342.97	1.89	2.33g
Demoranville	0	210.41	2.18	1.94g
Mullica Queen	2.79	355.80	1.88	2.25g
Scarlet Knight	1.15	263.77	1.74	1.81g
Stevens	25.41	125.08	1.29	n/a
CNJ93-20-155	9.50	458.35	1.73	2.30g
CNJ93-21-170	17.17	302.79	1.51	1.65g
CNJ93-21-309	1.70	262.82	1.96	2.30g
CNJ96-44-83	3.10	223.50	1.81	2.08g
CNJ96-46-14	5.01	397.19	1.75	n/a
CNJ99-52-15 (Welker)	25.66	370.73	1.79	2.15g
CNJ99-52-69	5.00	419.77	2.07	1.67g
CNJ99-9-25	23.91	396.87	1.77	2.00g
CNJ99-9-96 (Haines)	8.58	397.19	1.75	2.00g
NJS95-37	6.50	265.74	1.72	1.65g
NJS98-11	1.17	459.82	2.18	2.45g
NJS98-18	2.91	182.52	1.92	1.95g
NJS98-21	21.20	224.44	1.63	1.57g
NJS98-71	0.76	265.34	2.42	n/a
NJS99-4	4.61	421.73	1.64	2.35g

2015 Field Day

The September 8th Field Day took place at the Research and Demonstration Farm.

Lunch time addresses featured Kim Patten: The Research Farm - Progress to Date and Plans for the Future and Nick Vorsa: The Genetic Potential of Cranberry Cultivars for the 21st Century.

Fruit was picked from a one foot quadrant in each of the varietal trials from Field One (CNJ99-9-25, Crimson Queen, Haines, Mullica Queen, Welker, Demoranville, CNJ99-52-69, Scarlet Knight, Willipa Red and BG) and were on display in beakers so that growers and others could see examples of yield, colour, size and quality.

Field Day Demonstrations included

1. Biobest Canada Ltd. - Amanda Brown: Having a look at an established western bumblebee hive to see the activity going in and out and learning about bumblebee biology and behaviour.
2. Hortau Inc. - Caroline Letendre: Hortau's newest generation Smart station ST4 was installed in the cranberry field. Caroline explained the unit's main sensors for irrigation monitoring, soil tension, frost temperature and humidity probes.
3. Campbell's Gold Honey Farm and Meadery - Mike and Judy Campbell: Growers were able to observe the bee activity of the hives and were able to discuss with the beekeepers hive pollination potential and contract essentials.
4. Crop Sensors - Mike Morellato: The process of collecting data using unmanned aerial vehicles was demonstrated. Maps created from flights over the Farm were shared.
5. Riverside Welding and Fabrication - Todd and Parker Strukoff: The sprayer, designed for low impact on cranberry plants, 25' coverage and air induction nozzles for low drift was demonstrated.
6. Alfalfa Leaf Cutter Bees - Dominic Hauck: Growers learned about the alfalfa leaf cutter bee and its potential as an alternative/complimentary pollinator of cranberries.
7. Field Tours - Nick Vorsa and Kim Patten: Detailed tours of the cranberry fields were scheduled to discuss the varieties and trials.

Videos of the Field Day are posted to the Commission's website.

Harvest

The first farm harvest took place on October 21 and 22, 2015 with 542.47 barrels marketed to Ocean Spray under A contract.

In Closing

BCCRS

The BC Cranberry Research Society would like to express its sincere thanks to the many growers and others who gave countless hours of their time and their sharing of ideas and expertise to the development of this dedicated facility and working farm designed for research on aspects of cranberry production and for education purposes for growers and others.

The Farm has begun to help BC growers improve productivity, identify production limiting factors, and demonstrate an array of beneficial management techniques. The Farm is unique in Canada and the benefits to the industry will accrue over many years as current, and future generations of growers look to the Farm for answers and to demonstrate leading-edge production techniques.

cranberries

BC Cranberry Research Society

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