

Research Project Update 2021

Project Title

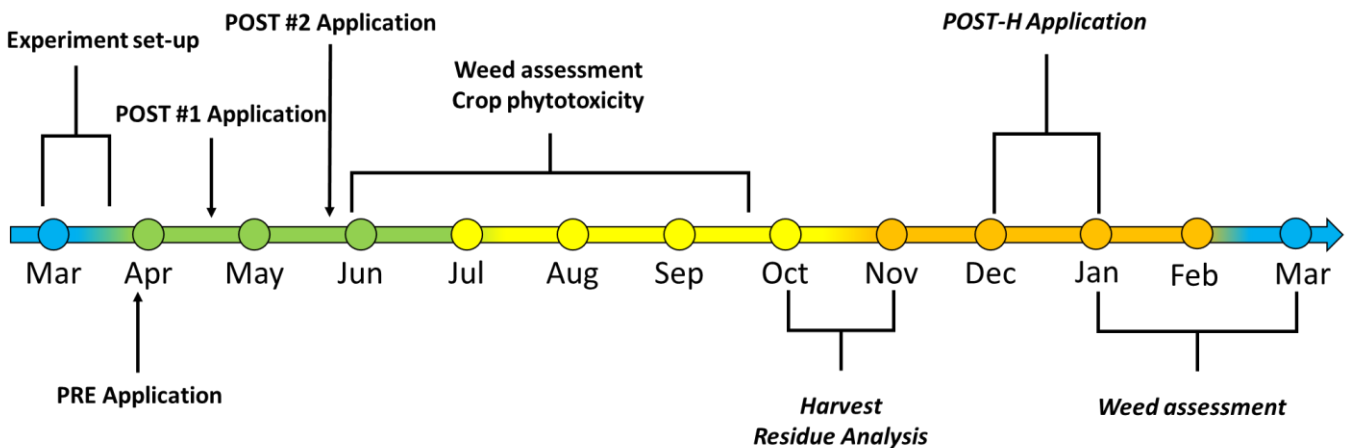
- Assessing an herbicide layering strategy in newly renovated and established cranberry fields

Project Team Members

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Project Progress Summary

- Project Health: ● Green
- Current Progress:



▪ Milestones

1. Field experiment preparation and set-up

1.1. Status: Completed (March 1 to March 12, 2021)

1.2. Milestone / Deliverable

- Design and set-up field experimental plots to evaluate the efficacy of layering pre-emergence, post-emergence, and/or post-harvest herbicides on the prevalent weed species in newly renovated and established cranberry fields.

1.3. Progress Assessment

- The field experiment focussing on weed management in recently renovated cranberry beds was set up at the Field 5 of the BC Cranberry Research Farm (BCCRF; Delta, BC; 49°06'06.1"N, 123°01'36.5"W). The field was planted in Spring 2020 with plugs of two-year-old plants, which are still establishing in the field.
- The field experiment on weed management in established cranberry beds was set up at the Golden Eagle Ranch (GER; Pitt Meadows, BC; 49°18'23.1"N 122°38'37.7"W). The field is well established and is at least 5 years old.

- Both fields were planted with Rutgers varieties (New Brunswick, New Jersey). The site at the BCCRF was planted with an unreleased numbered variety called “98-11” and the site at the GER was planted with a variety called Mullica Queen®.
- The BCCRF field is naturally infested with a variety of weeds while the GER field is highly infested with field horsetail (*Equisetum arvense*). The areas that have uniformly high weed pressure in both fields were identified and experimental plots were set up in those selected areas on March 12, 2021. The field experiment was designed as a randomized complete block design with four replications. The plots were 4 X 2 m with two-meter buffers between plots on all sides. These buffers were used as weedy-check plots (vs. the adjacent treated plots).

2. Weed survey

2.1. Status: Completed (March 16 to May 26, 2021)

2.2. Milestone / Deliverable

- Identify weed species present in the experimental plots
- Measure field estimate of their density and distribution

2.3. Progress Assessment

- Weed identification and weed density/distribution estimation in the experimental plots were conducted bi-weekly in both study sites from March 16, 2021 to May 26, 2021.
- In the BCCRF plots, 14 weed species are present. Weed species commonly found in the experimental plots include common sheep sorrel (*Rumex acetosella*), silvery sedge (*Carex canescens*), Himalayan blackberry (*Rubus armeniacus*) and cutleaf blackberry (*Rubus laciniatus*). However, weed distribution and density are spatially and temporally heterogeneous throughout the BCCRF plots.
- In the GER plots, 18 weed species are present, but their distribution was heterogeneous and density was low (less than 15%). Field horsetail (*Equisetum arvense*) is the most prevalent weed species in all the experimental plots (ranged from 60 to 90% density).

3. Herbicide weed control efficacy evaluation

3.1. Status: In progress (75% completed, Expected Completion Date: March 2022)

3.2. Milestone / Deliverable

- Evaluate weed control efficacy of the different herbicide layering treatments

3.3. Progress Assessment

- The herbicide types and treatments used in the current project are listed in Table 1 and 2. The pre-emergence herbicide treatments were applied on March 26 and 29, 2021 in the GER and the BCCRF plots, respectively. There was approximately 20 to 25 mm of rainfall within 3 days after the pre-emergence herbicide application at the GER while the BCCRF plots were irrigated for an hour using sprinkler after the pre-emergence application. In both sites, the first and second post-emergence herbicide treatments were applied on April 20 and May 26, 2021, respectively. Both the pre- and post-emergence herbicide treatments were applied using a

CO₂-pressurized backpack sprayer equipped with a four-nozzle boom fitted with 8002VS flat-fan nozzles (TeeJet Technologies, Wheaton, IL) spaced 50 cm apart and calibrated to deliver 200 L ha⁻¹ at 207 kPa.

- The post-harvest herbicide treatment will be applied between December 2021 and early January 2022 (depending on early winter weather condition). As a granular herbicide (i.e., Casoron G4), the post-harvest herbicide treatment will be applied using hand-held applicator (Spread-Rite G, PBI Gordon Corp).

Table 1. Herbicide types and application rates used in the present study.

Trade Name	Active Ingredient	Application rate	Surfactant (if needed)
Devrinol 2XT	Napropamide	4500 g ai ha ⁻¹	
Authority 480	Sulfentrazone	140.16 g ai ha ⁻¹	
Lontrel XC	Clopyralid	102 g ai ha ⁻¹	
Callisto 480SC	Mesotrione	100.8 g ai ha ⁻¹	Agral 90 (0.2% v/v.)
Poast Ultra	Sethoxydim	495 g ai ha ⁻¹	Merge (1L ha ⁻¹)
Casoron G-4	Dichlobenil	4400 g ai ha ⁻¹	

Table 2. Timing of treatment applications with phenological stages of the cranberry plant.

Treatment #	Phenological stage of cranberry			
	Pre-bud break	Bud break	Hook	Post-harvest
1	Napropamide	Clopyralid	Mesotrione + Sethoxydim	-
2	Napropamide	Mesotrione	Mesotrione + Sethoxydim	-
3	Sulfentrazone	Clopyralid	Mesotrione + Sethoxydim	-
4	Sulfentrazone	Mesotrione	Mesotrione + Sethoxydim	-
5	-	Clopyralid	Mesotrione + Sethoxydim	Dichlobenil
6	-	Mesotrione	Mesotrione + Sethoxydim	Dichlobenil
7	Napropamide	Clopyralid	Mesotrione + Sethoxydim	Dichlobenil
8	Napropamide	Mesotrione	Mesotrione + Sethoxydim	Dichlobenil
9	Sulfentrazone	Clopyralid	Mesotrione + Sethoxydim	Dichlobenil
10	Sulfentrazone	Mesotrione	Mesotrione + Sethoxydim	Dichlobenil

- Following the second post-emergence herbicide treatment application at the hook stage, all the experimental plots were assessed bi-weekly until harvest. The weed coverage (%) of individual weed species present within each plot was visually scored on a 0% (no coverage) to 100% (complete coverage) scale. The treated plots was compared to the untreated buffers adjacent to each plot to account for the inconsistent weed distribution and cranberry establishment throughout the study sites.
- In the BCCRF plots, weed distribution and density were spatially and temporally heterogeneous throughout the experimental plots. In addition, woody plants such as maple, birch, meadowsweet and blackberry became dominant throughout the experimental plots, making difficult to access to the plots and thus evaluate the

efficacy of the herbicide treatments. Hand-weeding of these woody plants will be conducted before applying the post-harvest herbicide treatment.

- In the GER plots, field horsetail was the most dominant weed species (ranged from 60 to 90% coverage); however, other weed species were heterogeneously distributed throughout the experimental plots and their density were low (less than 15%). As a result, the present study focused on the efficacy of the herbicide layering treatments on field horsetail control.
- Percent field horsetail control compared to the untreated checks after the herbicide layering treatments is shown in Table 3. In the GER plots, high level (60 to 86%) of field horsetail control was maintained until 112 days (September 16, 2021) after the treatment #4 and #10: the herbicide layering application of sulfentrazone (pre-bud break stage) + mesotrione (bud break stage) + mesotrione tank-mixed with sethoxydim (hook stage) (Table 3; Figure 1).

Table 3. Field horsetail (*Equisetum arvense* L.) control compared to the untreated check after the herbicide layering application.

Treatment#	June 9, 2021	June 24, 2021	July 22, 2021	Sept 16, 2021	Spring 2022
1	10 ± 4% c*	13 ± 8% c	9 ± 7% b	25 ± 16% c	TBD**
2	0% c	0 % c	10 ± 6% b	15 ± 10% c	TBD
3	42 ± 19% b	52 ± 19% b	50 ± 20% a	33 ± 19% bc	TBD
4	68 ± 4% a	80 ± 5% a	77 ± 5% a	71 ± 5% a	TBD
5	10 ± 4% c	14 ± 12% c	17 ± 10% b	39 ± 20% abc	TBD
6	15 ± 13% c	13 ± 9% c	20 ± 9% b	37 ± 5% abc	TBD
7	3 ± 2% c	19 ± 10% c	13 ± 6% b	12 ± 7% c	TBD
8	3 ± 3% c	11 ± 11% c	21 ± 7% b	23 ± 16% c	TBD
9	62 ± 2% ab	77 ± 2% ab	72 ± 7% a	49 ± 9% abc	TBD
10	60 ± 7% ab	86 ± 3% a	70 ± 13% a	69 ± 12% ab	TBD

* Means followed by the same letter do not differ significantly within columns (p=0.05)



Figure 1. The efficacy of the herbicide layering application of sulfentrazone + mesotrione + mesotrione tank-mixed with sethoxydim (Treatment #4 and #10) on field horsetail (*Equisetum arvense*).

4. Crop yield/safety/phytotoxicity assessment

4.1. Status: In progress (75% completed; Expected Completion Date: Fall 2022)

4.2. Milestone / Deliverable

- Evaluate the effect of the herbicide layering strategy on crop yield
- Establish the safety of the herbicide layering strategy by assessing crop tolerance and measuring herbicide fruit residues.

4.3. Progress Assessment

- Following the second post-emergence herbicide treatment application at the hook stage, all the experimental plots have been assessed bi-weekly. Cranberry tolerance to the herbicide treatments have been assessed by visually scoring the crop for overall injury on a 0% (no injury) to 100% (complete crop loss) scale.
- At both BCCRF and GER sites, the curling/cupping of cranberry leaves and the curling of vines were observed in the plots where clopyralid was applied at bud break stage. However, the plants recovered subsequently from phytotoxicity (approximately 2-3 weeks after the application), and no apparent effect on growth stage progression was observed as the plants started reaching the hook stage.
- As the BCCRF experimental plots are the newly renovated fields (planted in Spring 2020), evaluating the effect of the herbicide layering program on crop yield/safety assessments was not appropriate during the first year of the project.
- At the GER plots, ripened berries were harvested (hand-picked) on October 6, 2021 from two 0.25 m² areas randomly selected within each plot. The yield was ranged from 120 to 585 g m⁻²; however, there was no significant difference in crop yields among the herbicide treatments (p=0.22).
- A subsample of berries from the treatment determined to be most effective (i.e., Treatment #4 and #10) was sent to the local analysis labs (Bureau Veritas Canada and SGS Canada Inc.) to determine the herbicide residue on the berries. None of the active ingredients in the treatments was not detected.
- Crop residue of the post-harvest herbicide will be assessed in Fall 2022.

▪ Issues / Lessons learned

- The original plan was to evaluate herbicide weed control efficacy and crop phytotoxicity/yield by comparing the treated plot in relative to the untreated plot of each replicate block. However, as the experiment progressed, weed distribution/density and cranberry establishment were spatially and temporally heterogeneous throughout the study sites. As a result, the treated plots have been compared to the buffers adjacent to each plot (both left and right sides) to account for the inconsistent weed distribution and cranberry establishment issues.
- The post-emergence herbicide layering and application timing were modified due to the high risk of crop injury. The original plan was to apply clopyralid followed by mesotrione tank-mixed with sethoxydim at the following cranberry phenological stages (clopyralid applied at the first application timing): 1) cabbage head and hook; 2) rough neck and bloom; and 3) hook and fruit set. However, clopyralid application at the elongation and the hooking stages could result in significant crop injury and thus cause some issues on the ratings in newly

renovated/establishing cranberry beds (personal communication with Gavin Graham). Thus, the post-emergence herbicide layering has been modified in a way to cluster in the bud break to the hook stage window.

- In the BCCRF plots, as the experiment progressed, woody plants such as maple, birch, meadowsweet and blackberry became dominant throughout the experimental plots, making very difficult to access to the plots for weed/crop assessment activities. In addition, these woody plants outcompeted the weed species of concern present on local commercial cranberry fields (e.g., sheep sorrel). Thus, hand-weeding of these woody plants will be conducted before the post-harvest herbicide application in the winter and continued next year.