2015 Progress Report to the BC Cranberry Commission

Project Title: Assessment of new pest management tools that address priority needs of the BC cranberry Industry

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Project Summary: Control methodologies for cranberry tipworm, acceptable for export markets and compatible with chemigation, were assessed. Multiple applications of Sevin during first generation in May (7 days apart) were efficacious. Three applications were better than two; broadcast was better than chemigation. Optimal timing for first application could be based on the date of first tip curl, or for sites that are problematic and require three applications, the last application could be made 3 days for bees arrive, the earlier applications 7 and 14 days before that. All of the "soft" insecticides evaluated for efficacy were, at best, only effective for suppression. One new insecticide, not proposed for registration in BC, was very effective. Research trials on alternative fungicides applied at chemigation spray volume were assessed. At the time this report was due, plots were still being harvested and fruit rot data collection had not been completed. For the data collected to date, no major treatment differences have been noted. Trials to assess the efficacy of the new formulation of MET52 EC for blackvine weevil were conducted. Efficacy data will not be available until early 2016.

Indicators of success or challenge:
Tipworm: An alternative to Movento for tipworm control was assessed and found to provide reasonable efficacy. The use of this treatment, multiple pre-bloom carbaryl sprays, is not without concerns. It relies entirely on multiple applications of an old chemistry, and could easily lead to resistance. However, none of the alternative insecticides provided reliable, consistent efficacy.
Fruit rot: none yet, data pending
*Blackvine weevil***:** none yet, data pending

What your research accomplished and how the project impacted the industry:

- We conducted extensive testing in research plots and across whole farms to find alternatives to Movento for tipworm control. Our results indicate a reasonable alternative to Movento would be to target the first generation tipworm with multiple pre-bloom applications of carbaryl. While not a perfect solution, this protocol would give the industry an immediately available alternative to Movento should its use in the future not be an option.
- We conducted extensive testing of alternative fungicide programs to Bravo. Because data are still pending, we cannot yet project any impact to the industry.
- We conducted assessment of a new control option of blackvine weevil. Because data are still pending we cannot yet project any impact to the industry. If successful, this method could also become an optional method to control cranberry girdler.

Detailed Progress by Objective

Objective 1: Cranberry Tipworm - assess control methodologies acceptable for export markets and compatible with chemigation.

a*) First generation control for season-long suppression:*
Methods:
- Replication plots: Three grower sites with serious tipworm infestations were treated. There were two treatment comparisons: untreated control vs. carbaryl applied 5/6/15, 5/11/15 and 5/19/15. This corresponded to ~1, 7 and 15 days after first tip curling induced by tipworm, and with the last spray being applied just prior to scattered bloom. There were 3 replications per site, and treatments were applied by hand at 50 gpa. Efficacy was based on tip assessment for percent tip curled from tipworm and number of tipworm larvae per 25 uprights one month after the last treatment application.

-Whole farm treatments: Five farms with serious tipworm infestations in 2014 were studied. Three farms were assigned to our general first generation control protocol, with three pre-bloom first generation treatments of carbaryl, or carbaryl + orthene. Two farms used normal grower protocols of just Orthene or Orthene + carbaryl. Growers treated their whole farms with the assigned treatments. Efficacy was based on 10 quadrat counts of percent uprights with tipworm-affected uprights on 6/22/15 (second generation).

Results:
- Replication plots: Three prebloom carbaryl sprays significantly reduced second generation tipworm populations and impacts on cranberry uprights (Figures 1 and 2). This was significant and noted for all three farms. We did not assesse this further out into the year to see how long the control held, and it did not totally eliminate all the cupping. However, the reduction in percent curling and the new larvae and pupae populations one month post-treatment might have been adequate to minimize the impact to the current or next season crop.

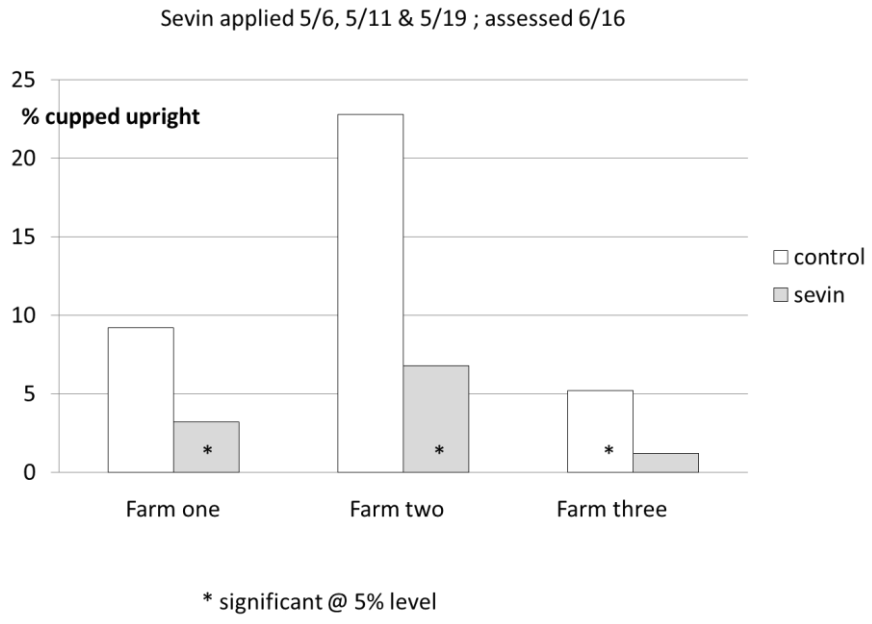
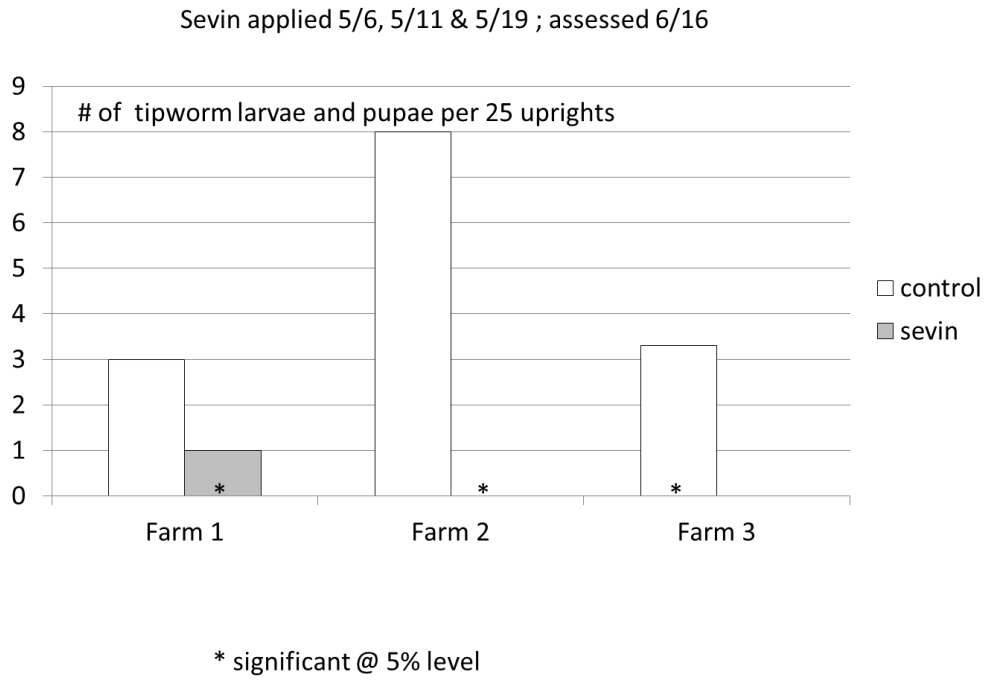


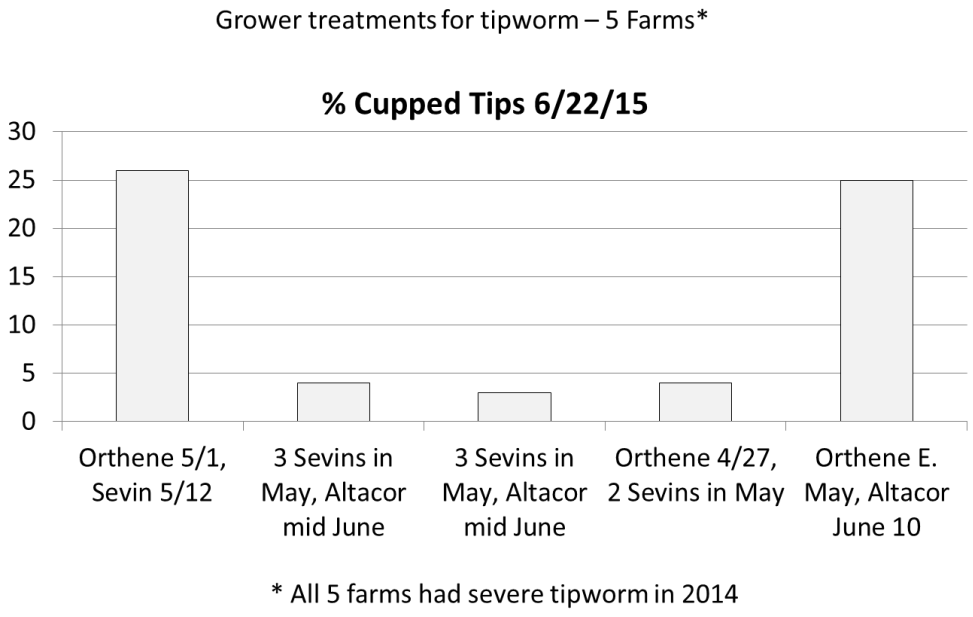
Figure 1. Percent of uprights with tipworm-induced cupping on 6/19/15, one month after the last carbaryl treatment.

Figure 2. Number of tipworm larvae and pupae per 25 uprights on 6/19/15, one month after the last carbaryl treatment.



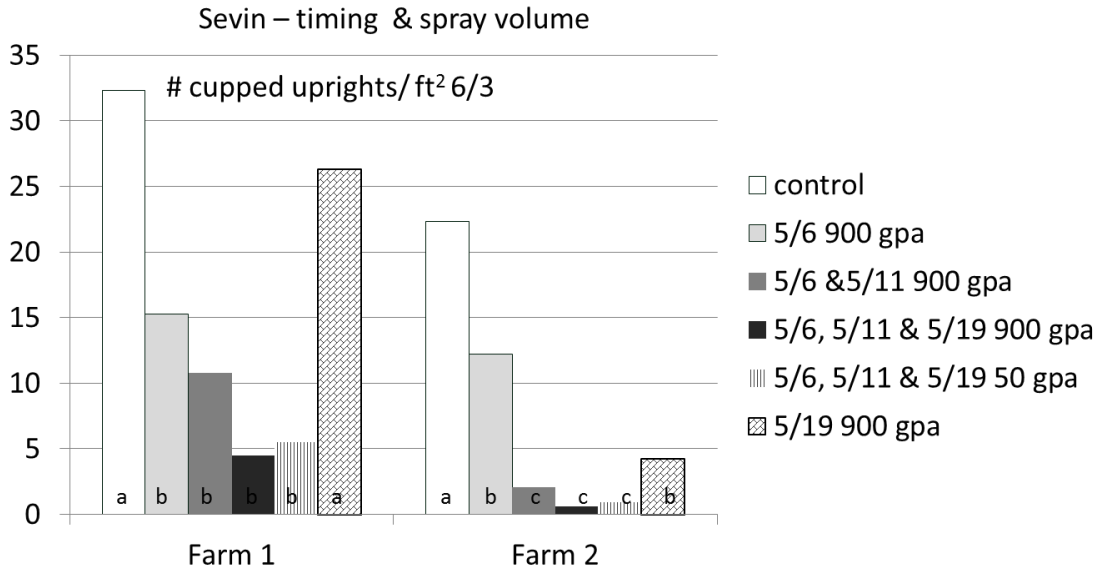
-Whole farm treatments: Percent second generation infestation (cupped tips late June) on the three farms which received three insecticides to control first generation tipworm had five-fold lower levels of infestations than the two farms that only had one or two treatments in May to control tipworm (Orthene + Sevin, or just one Orthene) (Figure 3). These whole farm grower-applied treatments strongly support the concept that rigorous treatments to control first generation tipworm in May will suppress second generation populations and reduce the potential impact to current and next year crop.

Figure 3. Percent of uprights with tipworm-induced cupping on 6/22/15, on five farms in Grayland Washington with different treatments for first generation control of tipworm.



b) *Timing for first generation control for season-long suppression:*
-*Methods:* Replicated research trials were conducted on two farms with serious tipworm infestations to assess effectiveness of different pre-bloom applications of carbaryl. There were four timings and two application methods. Carbaryl was applied at 900 gpa spray volume on 5/6/15, 5/6/15 + 5/11/15, 5/6/15 + 5/11/15+ 5/19/15 and 5/19/15, or at 50 gpa 5/6/15 + 5/11/1+ 5/19/15. Efficacy, larvae and pupae populations, percent infested uprights and number of cupped uprights/ft^2 were compared to an untreated control.

-*Results*: One treatment of carbaryl, early or late, was not adequate to consistently control tipworm (Figure 4). Two or three sprays gave best control. Three sprays provided the best numerical level of control. There was no improvement in efficacy by using broadcast instead of chemigation application rates.



c) N*ew chemistries for chemigation – tipworm control:*
Methods:
-Replicated studies: Grower sites with serious tipworm infestations were treated. In one set of experiments at two grower locations, cyazypyr and bifenthrin were applied at 750 gpa in 4 replicated plots on 5/21/15 and 5/25/15. Plots were assessed for tipworm and damage on 6/9/15 and 6/16/15. In another set of experiments, comparisons were an untreated control, Altacor, Delegate, Azera (azadirachtin 1.20%, Pyrethrins 1.4%), Pyganic and Sevin. There were 4 replications per site, three sites, and treatments were applied by hand at 750 gpa, except for Delegate, which was applied at 50 gpa. Treatments were applied twice 5/21/15 and 5/21/15. Plots were assessed for tipworm and damage on 6/9/15 and 6/15/15.

- Relative efficacy of different insecticides, a summary over time: Data from ten chemistries compared across dozens of replicated efficacy trials in 2010, 2014 and 2015 were pooled. Efficacy was based on number of larvae and pupae in a 25-upright sample, 7 and 14 days after treatment, percent damaged buds, and percent tip curl. It was based on percent control relative to the untreated check. Comparisons were made by application volume and number of applications. Data are presented in box whisker graphs. The boundary of the box closest to zero indicates the 25th percentile, a line within the box marks the median, and the boundary of the box farthest from zero indicates the 75th percentile. Whiskers (error bars) above and below the box indicate the 90th and 10th percentiles. Basically, the graph shows relative control and the consistency of the control. A tight box with high percent control means all the data were clusters and the results were consistent across all experimental plots. A wide box indicates highly variable efficacy across studies, with lots of outliers.

Results:
-Replicated studies: For Farm K, bifenthrin at 750 gpa spray volume provided excellent control and cyazypyr at 750 gpa spray provided moderate control of tipworm (Table 1). The level of infestation at Farm J was not sufficient to make any inferences, but, based on percent cupped uprights, both chemistries reduced infestation. Of the five insecticides compared in the second study, only Sevin showed consistent efficacy across farms and parameters assessed (Table 2).

-Relative assessments with pooled data over time: These were not all direct side by side comparisons, but, based on the overall data in Figure 5, efficacy tended to be reduced for all bifenthrin, cyazypyr and Sevin when chemigation was compared to broadcast application. For two applications of bifenthrin and three of Sevin, the differences between application methods were minimal. The relative efficacy of ten different insecticides applied twice by broadcast indicated that with the exception of bifenthrin and Sevin, the medium % control was around 40% and was highly variable (Figure 6). For bifenthrin and Sevin, however, the medium % control above 80%, and results were very consistent across experimental studies .

Table 1. Effect on tipworm control of cyazypyr and bifenthrin applied at 750 gpa.								
	Farm J - # tipworm/25 uprights 6/9/15			Farm K - # tipworm/25 uprights 6/16/15			% cupped uprights	
Treatment	Larvae	Pupae	Total	Larvae	Pupae	Total	Farm J	Farm K
Control	0.5	2	2.2	7	1.3	8.5	12	28
Cyazypyr	0	1	0.5	3.5	0.3	4	4	12
Bifenthrin	0	0.3	0.1	1.3	0	1.3	2	10
Lsd	.	2	8	3	5	3	12	10
F test sign.	.	.3	0.2	0.01	0.06	0.003	0.15	0.01

Table 2. Effect on tipworm control of Altacor, Azera, Pyganic, and Sevin applied at 750 gpa, and Delegate applied at 50 gpa.						
	Farm W - Total larvae +pupae		Farm K - Total larvae +pupae		% cupped uprights 6/15/15	
Treatment	6/9/15	6/9/15		6/15/15	Farm W	Farm K
Control	6.1	18		8.8	38	31.2
Altacor	10.7	17.5		3	54	23.2
Delegate	5.4	6.5		8	19.2	30
Azera	5.3	10.5		5.3	30	31.2
Pyganic	9.4	11.5		5.8	34	26
Sevin	2.5	2.9		1	24.8	5.2
LSD	0.9	11		2.7	18	10
F test sign.	0.01	0.07		0.01	0.01	0.004

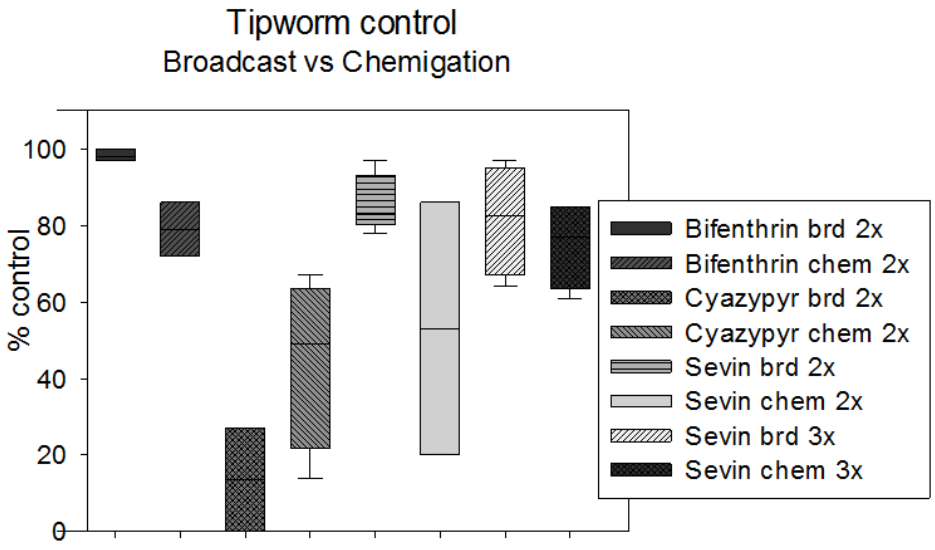


Figure 5. Box whiskers graph of the relative efficacy of bifenthrin, cyazypyr and sevin for tipworm control applied with broadcast and chemigation spray volumes.

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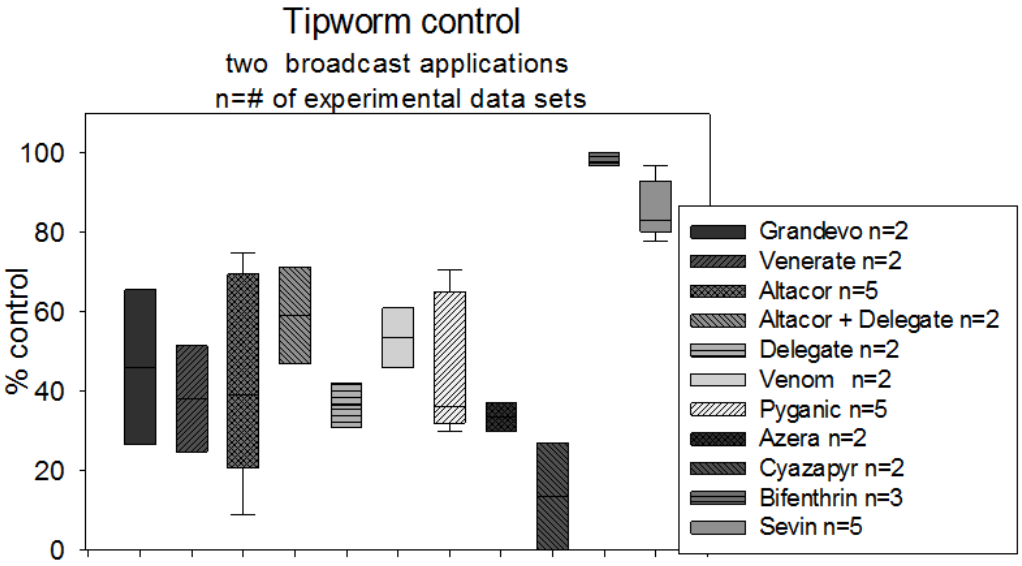

Figure 6. Box whiskers graph of the relative efficacy of ten different insecticide treatment for tipworm control applied with broadcast spray volume.

Objective 2: Fungicide alternatives compatible with chemigation:
Methods: Research trials on alternative fungicides applied at chemigation spray volume were assessed. Plots were 6' x 6' plots with 5 replications per site. Treatments were applied at 4 to 5 sites with previous history of high field rots. Treatments were applied at 15 to 20% bloom and repeated in 5 to 7 days. The following treatments were compared: Quardis, Quardis Top, Proline, Oso, Propulse, Regalia, mandestrobin, Double Nickel, and Proline + Quardis. All treatments were applied at label rates at chemigation spray volumes, 800 to 1200 gpa. Percent field rot and yield were assessed at harvest, and keeping quality after 6 weeks of storage.

Results: At the time this report was due, only 3 of 6 experimental plots had been harvested and fruit rot assessed. Final data for this objective won't be available until early 2016. For Crimson Queen on commercial growers' farms, there was no difference in yield or fruit rot between fungicide treatments (Table 3). However there was a trend for lower yield and higher fruit rot with the mancozeb treatment. For BG's, two Bravo applications resulted in higher yield than other fungicide treatments, but there was no effect of fungicide on field rot (Table 4). For an organic Crimson Queen bed there was no effect of organic fungicides on yield or field rot (Table 5).

Table 3. Fungicide effect on yield and fruit rot of Crimson Queen at Grower M's bed.		
Treatment*	Bbl/ac good fruit	% field rot
Control	367	3.5
Indar	434	1.5
Abound	496	3.7
Indar + Abound	420	3.6
Proline + Abound	487	3.1
Proline	452	2.7
Mancozeb	310	6.6
F significance levl; LSD @ 0.05	0.2; 160	0.09;0.3
*Treatment applied at full label rates with chemigation spray volume, two applications, 7 days apart, starting at early bloom		

Table 4. Fungicide effect on yield and fruit rot of BG's at the PCCRF		
Treatment*	Bbl/ac good fruit	% field rot
Control	240	14
Proline + Abound	281	17
Quadris	312	19
Bravo	428	13
F significance level; LSD @ 0.05	0.0; 80	0.3;0.2
*Treatment applied at full label rates with chemigation spray volume, two applications, 7 days apart, starting at mid bloom		

Table 5. Fungicide effect on yield and fruit rot of Crimson Queen at an organic farm		
Treatment*	Bbl/ac good fruit	% field rot
Control	73	14
Double Nickel	78	17
Regalia	55	19
Trilogy	84	13
F significance level; LSD @ 0.05	0.2; 28	0.6; 6
*Treatment applied at full label rates with chemigation spray volume, two applications, 7 days apart, starting at early bloom		

O*bjective 3: Blackvine weevil control with summer applications of MET52 EC*. In 2015 we assessed the efficacy of the new formulation of MET52 EC applied in August. Treatments were applied at four sites on 10' x 10' plots with 5 replications per site. Site selection was based on evidence of weevil damage. Treatments were an untreated control and the label of MET 52 EC applied at chemigation volume and irrigated in ample water post-treatment. Efficacy data has not been collected, and will be available early 2016.