Progress Report 2013 to the BC Cranberry Marketing Commission

Project Title: Reduced-risk Pest Management and New Herbicides for Cranberries in BC
Kim Patten and Chase Metzger, Washington State University Long Beach Research and Extension Unit.

Project Summary: Numerous trials on the efficacy and phytotoxicity of indaziflam as a function of timing and rate were conducted. Results indicated that several important weeds were controlled, without risk to the crop. Numerous trials were conducted to assess efficacy of unregistered and newly registered insecticides on fireworm, tipworm and blackvine weevil. Several new insecticides show promise for fireworm and tipworm. The duration of efficacy of Altacor and Intrepid for first and second generation fireworm was assessed, and found to be 2 to 3 weeks.

Project Results by Objectives:

Indaziflam herbicide for cranberry weed control. Several experiments were conducted to assess efficacy and phytotoxicity of indaziflam on young and establish cranberry beds. Indaziflam was effective on lotus (Tables W-1, W-2, W-3), St. John's Wort (Tables W-1, W-2), annual grasses (barnyard grass and annual blue grass) (Table W-3), rushes (slender rush and toad flax) Table W-1, W-3), willow seedlings (Table W-3). Efficacy varied by bed, rate and timing. For example, the 1.25 oz/a rate did not work on St. John's Wort in February, but it did in March, while a higher rate was effective in February (Table W-1). No effect of indaziflam was noted on cranberry yield (Tables W-4 and W-5). There were no significant visual phytotoxicity symptoms of indaziflam on treated cranberries (Table 5-1), but there was a trend for thin, weak vines to show some stress symptoms.

Table W- 1. Effects of indaziflam rate and timing on weed control in bare areas within cranberry beds in 2013.

		Farm 1				Farm 2
		%cover 5/30/2013				% cover 8/22/2013
Treatment		Horsetail	Toad flax	Lotus	Bentgrass	St. John Wort
Control		38	55	37	22	71
Indaziflam 1.25 oz/a	February	32	43	32	3	57
Indaziflam 2.5 oz/a	February	5	17	7	13	3
Indaziflam 1.25 oz/a	March	40	33	32	3	13
Indaziflam 2.5 oz/a	March	17	8	5	10	3
LSD (P=.05)		51	25	30	16	2
Treatment Prob(F)		ns	0.05	0.10	0.12	0.005

Treatments applied 2/20/13 and 3/15/13

Table W-2. Effects of indaziflam on lotus control within cranberry beds in 2013.		
	% lotus cover 6/3/2013	
Treatment	Farm 1	Farm 2
Control	53	54
Indaziflam 5 oz/a 3/11/13	0.7	0.2
Treatment Prob(F)	0.03	0.03

Treatments applied 2/20/13 and 3/15/13

Table W-3. Effects of indaziflam rate and timing on weed control in bare areas within nonbearing cranberry beds in 2013																							
		Lotus				Pointed broom sedge		Slender rush		Barnyard grass		Willow (*s. Lucida*)		Western St. John's Wort				Annual bluegrass					
		Farm 1		Farm 1		Farm 2		Farm 2		Farm 2		Farm 2		Farm 3		Farm 4		Farm 5		Farm 3			
		% coverage										# seedlings /36 ft^2		% control		% coverage							
treatment		6/13		7/19		7/17		7/17		7/17		7/17		7/18		7/17		7/14		7/17			
Control		78	a	83	a	18	a	27	a	0	b	16	a	0	b	35	a	70	a	60	a		
Indaziflam 1.25 oz/a	Feb	2	b	17	b	3	a	0	b	67	a	2	b	93	a	5	b	12	b	46	a		
Indaziflam 2.5 oz/a	Feb	0	b	2	c	3	a	5	b	83	a	3	b	97	a	11	b	20	b	50	a		
Indaziflam 1.25 oz/a	Mar	0	b	4	c	3	a	1	b	83	a	4	b	100	a	3	b	25	b	30	a		
Indaziflam 2.5 oz/a	Mar	0	b	2	c	0	a	2	b	97	a	3	b	97	a	0	b	8	b	10	a		
LSD (P=.05)		6		10		15		6		43		4		9		16		15		37			
Treatment Prob(F)		0.0001		0.0001		ns		0.0001		0.006		0.001		0.0001		0.007		0.0001		0.08			

Treatments applied 2/20/13 and 3/15/13
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

Table W-4. Effects of indaziflam rate on cranberry yield in 2013			
	Yield (bbl/ac)		
	Farm 1	Farm 2	Farm 3
Treatment	Stevens	McFarlin	McFarlin
Control	91	250	92
Indaziflam 2.5 oz/a	79	232	75
Indaziflam 5 oz/a	81	229	86
Indaziflam 10 oz/a	92	214	77
LSD (P=.05)	33	134	48
Treatment Prob(F)	0.71	0.93	0.80

Treatments applied 3/20/13 on Farm 1, 4/16/13 on Farms 2 & 3

Table W-5. Effects of indaziflam rate and timing on cranberry phytotoxicity and yield in cranberry beds in 2013					
		Cranberry phytotoxicity rating 1=none, 5=severe			Yield Bbl/ac
Treatment		Willapa Red 7/18/2013	Crimson Queen 7/17/2013	Crimson Queen (weak/thin vines) 7/17/2013	Willapa Red
Control		1.3	1.2	1.5	141
Indaziflam 1.25 oz/a	February	1.2	1.0	1.3	118
Indaziflam 2.5 oz/a	February	1.7	1.2	1.8	122
Indaziflam 1.25 oz/a	March	1.3	1.2	1.9	158
Indaziflam 2.5 oz/a	March	1.5	1.7	2.5	80
LSD (P=.05)		0.6	0.7	0.9	42
Treatment Prob(F)		ns	ns	ns	ns

Treatments applied 2/2/13 and 3/19/13

New insecticide chemistries for control of fireworm and tipworm. Several experiments were conducted to assess new chemistries for efficacy. In first generation fireworm trials we found very weak efficacy of sulfoxaflor and very good efficacy of flubendiamide (Table I-1, and no efficacy of Grandevo (Table I-2). In second generation fireworm trials, we found no efficacy of Grandevo or Venerate, and good efficacy of Danitol and Altacor (Table I-3). For early season tipworm control, first generation, we found cyazypyr and Venom effective at both farms on larvae, but there was no treatment effect on pupae, only larvae. The degree of efficacy depended on the farm, sampling time after treatment and chemistry. Best results were obtained with June sampling time after two applications. Sulfoxaflor reduced larvae in one farm in at the June sample time. For late season tipworm control Fenpropathrin was moderately effective (Table I-5).

Table I-1. Efficacy of sulfoxaflor and fludendimide on frist generation fireworm in 2013																					
	small alive		medium alive		large alive		total dead		total alive		small alive		medium alive		large alive		total dead		total alive	
	# fireworm per 5 sweeps																			
treatment	5/13/2013										5/20/2013									
Control	5.7	a	15.7	a	22.7	a	0	b	44	a	0.7	a	5	a	8.3	a	0	a	14	a
Sulfoxaflor 1.5 oz/a	2.3	a	9.7	a	10	a	0.7	b	22	ab	0	a	5	a	9.7	a	0	a	14.7	a
Flubendimide 4 oz/a	0	a	0	b	0	a	30	a	0	b	0.3	a	0	a	0	b	8	a	0.3	b
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)																				

Table I-2. Efficacy of Grandevo applied 5/16/13 on first generation fireworm

Treatment	Total alive larvae 5/20/13 per 5 sweeps
Control	17.8
Grandevo 3 lb/ac w/ x77 0.25%	20.8
	no significant difference

Table I-3. Efficacy of Grandevo, Venerate, Danitol and Altacor applied 7/19/13 on second generation fireworm.

	Total alive larvae 7/29/13 per 5 sweeps		
Treatment	Small	Medium	Large
Control	3 a	2.8 a	3.8 a
Grandevo 3 lb/ac	1.5 a	2.8 a	2.0 a
(MBI-206) 2 gal/a	3 a	2.5 a	1 a
fenpropathrin 16 oz/a	0 b	0 b	0 b
Altacor 4 oz/a	0 b	0 b	0 b

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

Table I-4. Effect of sulfoxaflor, cyazapyr, Vemon on early season tipworm populations in 2013

	# per 25 uprights											
	Larvae	Pupae	Larvae	Pupae	Larvae	Pupae	Larvae	Pupae	Larvae	Pupae	Larvae	Pupae
	Johnson farm						Summer farm					
treatment	5/23/2013		5/30/2013		6/10/2013		5/23/2013		5/30/2013		6/10/2013	
Control	2.3	0	4	0	8.5	2.3	1.5	0	3.5	0	2.3	2
Sulfoxaflor 1.5 oz of product/a	0.3	0	2.5	0	4.5	3.5	1.5	0	1.8	0	1	2.5
Cyazapyr (HGW 86) 10.1 oz/a	0.8	0	5.3	0.3	1	2	1	0	1.8	0	0	3
Venom 4 oz/a	2	0	1.8	0	0.5	2.3	0	0	2	0	0.3	0.8
LSD (P=.05)	2.2	0	5.43	0.4	4.76	3.29	1.25	0	3.84	0	1.71	2.56
Treatment Prob(F)	ns	ns	ns	ns	0.01	ns	0.07	ns	ns	ns	0.05	ns

Treatments were applied 5/15/13 and 6/3/13

Table I-5. Effectiveness of late fenpropathrin on tipworm control

Treatment	# of total larvae and pupae/25 uprights 2 and 5 days after treatment
control	13.3
fenpropathrin 32 oz/a	7
Treatment Prob(F)	0.05

Treatment was applied 8/13 and assessed 8/2/13 and 8/5/13

Timing of reduced-risk insecticides for fireworm control. Two studies were done to assess timing of Altacor and Intrepid for first generation fireworm control to determine if an application applied too early (pre-hatch), or if applied on large larvae still provides efficacy. We treated a severely infested bed prior to egg hatch or any observed neonates and followed larvae population buildup over time. Both Intrepid and Altacor lasted the entire first generation, up to 5/17/13 sweeping (Table I- 6). Application of these insecticides on larvae once they were already large also provided 100% efficacy (Table -7). These results suggest the timing of first generation sprays is not too critical and efficacy is provided over a long duration.

Table I-6. Effects of early timing, pre-egg hatch, on first generation blackheaded fireworm control in 2013

	# Alive blackheaded fireworm larvae per 5 sweeps															
	Small		Medium		Large		Total		Small		Medium		Large		Total	
Treatment	5/6/2013								5/17/2013							
Control	24.8	a	5.8	a	0.5	a	31	a	1.3	a	6.5	a	13.8	a	21.5	a
Intrepid 16oz/ac	0	b	0	b	0	a	0	b	0	a	0	a	0	b	0	b
Altacor 4 oz/ac	0.5	b	0	b	0	a	0.5	b	0	a	0	a	0	b	0	b
LSD (P=.05)	16.29		0.96		1		15.34		1.5		5.91		2.5		8.65	
Treatment Prob(F)	0.01		0.0001		0.4		0.004		0.1		0.05		0.0001		0.001	

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls
Treatments were applied 4/30/13.

Table I-7. Effects of Altacor and Intrepid on large instar first-generation blackheaded fireworm in 2013.

	# larvae per 5 sweeps															
	Alive		Dead		Alive		Dead		Alive		Dead		Alive		Dead	
Treatment	Small				Medium				Large				Total			
Control	0.7	a	0	a	5	a	0	b	8.3	a	0	a	14	b	0	a
Intrepid 16 oz/ac	0	a	0	a	0	a	13.3	a	0	b	0	a	0	a	13.3	b
Altacor 4 oz/ac	0	a	2.7	a	0	a	10.3	a	0	b	0	a	0	a	13	b

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
Treatments were applied 5/14/13 (61% of larvae were 4th and 5th instar & 31% were 3rd instar). Plots were swept 5/20/13.

Assess the ovicidal properties of Altacor and Intrepid for fireworm control. One gallon potted containers of cranberries were treated with Altacor and Intrepid at different dates and those containers moved into a field with high fireworm egg laying activity for 5 days. The percentage of containers with larval infestation was monitored at hatch. Results, shown below, were highly variable. Best control was obtained with Intrepid when applications were made 1 and 5 days after egg laying exposure, while Altacor had activity from 10 days before egg laying to 10 days after. This design does not allow us to tease out ovicidal properties vs. long-term residual larvicidal properties on the neonates. It does indicate at least that Intrepid is unlikely to have much ovicidal activity when applied just prior to ovideposition.

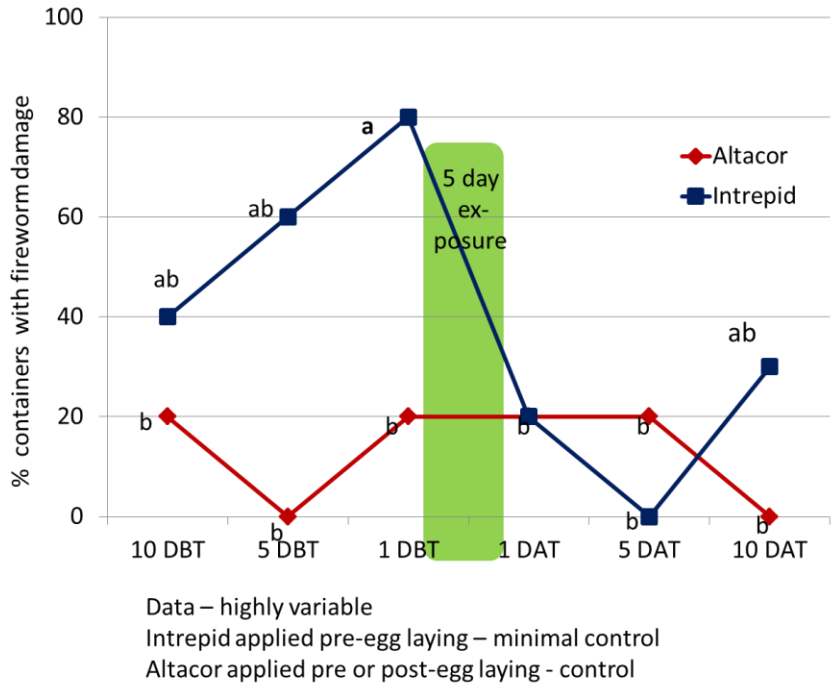

Figure I-1. Effect of pre and post oviposition treatment on the occurrence of fireworm larvae in 2013.

Systemic root uptake activity of Altacor for fireworm control. Field trials were conducted where small plots of vines were spot treated under the leaves into the root zone at an earlier instar stage of 2nd generation with Altacor. Three grower locations were used. Uprights were examined for viable larvae. Live viable larvae were found on uprights at all the sites on the treated plots. This suggested that there is minimal root uptake and translocation of Altacor to the new growth.

Duration of efficacy for field-aged insecticides against BHFW larvae. Several experiments were conducted to assess how fast efficacy declines following a field application.

1) Diazinon, Altacor, Intrepid, Avaunt, Delegate, Orthene, and cyazypyr were applied to small plots and upright samples collected at different time intervals. Blackheaded fireworm larvae were collected and placed on the uprights in the lab. Mortality was assessed. Survival of larvae under lab conditions was low and data generated were not significant. The study will be repeated in 2014 using different laboratory parameters.
2) The efficacy of Altacor and Intrepid applied at 5 separate timings for second-generation fireworm control was assessed. Replicated plots were treated between 5/27/13 and 6/26/13 and the number of larvae per 5 sweeps recorded when first significant hatch was found by sweeping immediately adjacent to the plots. The table and graph below provides sweeping results, along with pheromone trap and sweeping results for that bed, based on sweeping data on 7/8/13. Treatments applied earlier (5/27/13 and 6/4/13) failed to last long enough to provide significant control. The longest time period Altacor provided control for was when it was applied on 6/11/13 (33 days). The longest Intrepid provided control was when it was applied on 6/19/13 (19 days).

Table I-7. Duration of efficacy for Altacor and Intrepid against 2nd generation fireworm.									
				Small larvae		Medium larvae		Total larvae	
Treatment				# larvae /5 sweep on 7/8/2013					
Date applied	Control (outside plots)			13.3	a	3	a	16.3	a
5/27	Altacor	4	oz/a	12.3	a	2.3	a	14.7	ab
5/27	Intrepid	16	oz/a	10.7	a	2.3	a	13	ab
6/4	Altacor	4	oz/a	9.7	a	0.3	a	10	b
6/4	Intrepid	16	oz/a	8.7	a	2.3	a	11	ab
6/11	Altacor	4	oz/a	3.3	b	0.3	a	3.7	c
6/11	Intrepid	16	oz/a	10.7	a	3	a	13.7	ab
6/19	Altacor	4	oz/a	2.7	b	0	a	2.7	c
6/19	Intrepid	16	oz/a	2.3	b	0.3	a	2.7	c
6/24	Altacor	4	oz/a	0	b	0.3	a	0.3	c
6/24	Intrepid	16	oz/a	1.7	b	0	a	0.7	c
LSD (P=.05)				3.94		2.54		4	
Treatment Prob(F)				0.0001		0.0668		0.0001	

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

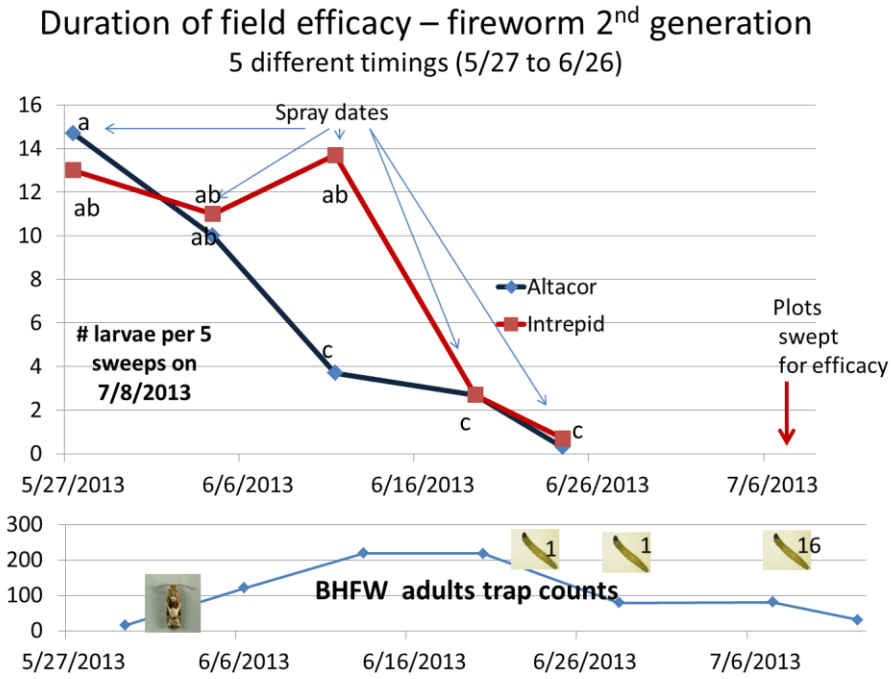

Figure I-2. Effect of early timing, pre-egg hatch, on first-generation blackheaded fireworm control in 2013.

Blackvine Weevil control with MET 52 formulations. MET 52 was applied to infested sections of cranberry beds. There were 12 replicated plots of 4 treatments: control, 2 rates of MET 52 and 1 rate of Venom. The MET 52 G formulation was used. Spores were liberated from the granules by soaking for 3 hours in a 0.1% solution of Silwet. Treatments were applied in August with 2000 gpa and watered in with 2000 gpa. Plots were assessed in September, but larvae were too small to readily find. Treatments will be re-assessed in December. No data is available for this report.

Project accomplishments:

Weed control: A comprehensive study on the value of the herbicide indaziflam to cranberry weed control was conducted. The study's parameters included efficacy and crop safety for different rates and timings. Indaziflam has potential to become a very useful long-lasting pre-emergent herbicide for cranberries. It appears to provide season-long control of several of BC's most problematic cranberry weeds without risk to the crop. Subsequent research would be the residue work required to secure a registration. Since Bayer recently put its cranberry project on hold, no additional work will be required at this time.

Insect control: New chemistries were tested on fireworm, tipworm and blackvine weevil. Additional studies were conducted to understand the nuances of how to most effectively use Intrepid and Altacor for fireworm control. A few new insecticides might have potential for fireworm or tipworm. This research will help growers obtain better efficacy from Altacor and Intrepid on fireworm. It will provide useful efficacy data for cyazypyr label on tipworm. Subsequent work will be to confirm the long duration of efficacy for early timing of Altacor for first-generation fireworm, and additional efficacy testing of new chemistries on tipworm.

Funding for this project has been provided by Agriculture and Agri-Food Canada through the Canadian Agricultural Adaption Program (CAAP). In British Columbia this program is delivered by the Investment Agriculture Foundation of BC.

Funding provided by:

Investment Agriculture Foundation of British Columbia

Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada