2007 Progress Report

British Columbia Cranberry Commission

Development of effective management strategies for tipworm, girdler, fireworm, and perennial weeds.

Principal Investigator: Kim Patten, Washington State University,
Long Beach Research and

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Objectives:

1. Evaluate reduced-risk chemical controls of tipworm, girdler and fireworm.
2. Evaluate effective management strategies for priority weed species using new herbicides, adjuvants and application technologies.

Objective 1: Evaluate reduced-risk chemical controls of tipworm, girdler and fireworm:

<u>Girdler:</u> Cranberry girdler trials were conducted at two sites in Long Beach and two in Grayland, Washington. Nemasys nematodes *(Steinernema carpocapsae)* from Becker Underwood were applied in small (5 'x 5 ') replicated plots (16) with high adult girdler activity in grower beds in early August. Larvae counts were made in mid-September, prior to pupation. No girdler larvae were found at any of the sites in significant enough levels to provide any meaningful data.

<u>Tipworm:</u> Trials on tipworm were conducted at two replicated sites (6'x'6' plots, 4 replications) in Grayland, comparing the efficacies of rynaxypyr (DPX-E2Y45), flubendiamide (NNI-480), metaflumizone (BAS320), Spirotetramat (Movento), and *Bacillus thuringiensis* Berliner subsp. *israelensis* (*Bti*) (Gnatrol). An untreated control and Diazinon treatment were used as comparisons. Four applications (10 to 14 days apart) were made, starting with first generation hatch, and continued to mid-July. Efficacy was measured based on the level of undamaged terminals, and larvae and pupae found in tips. By the end of the spray season, all the control data had lost significance because of excessive pressure from surrounding untreated plots. The best efficacy data was collected earlier and is shown in Table 1. Diazinon provided the best control at both sites. Movento had good control at site 1, but was less impressive at site 2. None of the other products provided consistent significant control on par with Diazinon. At the end of the spray season Movento plots had some phytotoxicity in the form of leaf burning. Overall, these results are discouraging; no one product has comparative efficacy to Diazinon. However additional trials with Movento and DPX are warranted.

Table 1. Tipworm control in two farms in Grayland Washington in 2007.							
		Site one			Site two		
		% cupped tips	% terminal buds with foraging damage	% tip with tipworm pupae	% cupped tips	% terminal buds with foraging damage	% tip with tipworm pupae
Treatment	Rate	6/27/2007	6/27/2007	6/27/2007	7/5/2007	7/5/2007	7/5/2007
CONTROL		17	17	9	27	19	12
DPX-E2Y45	0.066lb ai/a	27	20	5	22	17	12
BAS320	18.3fl oz/a	17	13	10	29	19	13
GNATROL	128oz/100 gal	39	33	17	32	29	17
NNI-480	4oz/a	42	37	17	25	19	10
MOVENTO	16oz/a	12	5	0	27	15	12
DIAZINON AG600	2qt/a	5	3	2	12	2	0
LSD (P=.05)		14	11	8	10	11	9
Treatment Prob(F)		0.0001	0.0001	0.0016	0.0136	0.0082	0.0403
* Treatments applied 5/10/2007, 5/24/2007, 6/13/2007, and 6/27/2007 on 4 replicated plots per site. Data collected from 15 uprights per plot. Data collected included larvae, pupae, and damage assessments every two weeks. Only the significant data are shown.							

<u>Fireworm:</u> Trials on fireworm were conducted in growers' fields to assess the efficacy of flubendiamide, metaflumizone, and rynaxypyr on second generation fireworm larvae. An untreated control and Diazinon treatment were used as comparisons. Treatments will be applied in early July using simulated chemigation (450 gpa application volume followed by 225 gpa rinse) to 6 replicated plots (10' x 10') in abandoned grower beds with high adult moth activity. Efficacy data was based on sweeping beds for larvae, and the amount of feeding damage on foliage.   All the new chemistries had reasonable efficacy when applied with high-volume broadcast methods, none have the level of control of Diazinon when applied via chemigation (Table 2). These results are discouraging since efficacy via chemigation is required for an insecticide to be considered a true replacement for an organophosphate. We replicate this study on several other farms, but fireworm populations were never adequate to make inferences. Research on chemigation efficacy will have to be done in subsequent years on additional chemistries. Other trials were conducted with just broadcast application assessing the efficacy of

novaluron on second generation fireworm. It was very effective (data not shown), but needs to be assess using chemigation.

Table 2. Efficacy of various insecticides for first generation fireworm control at a farm in Long Beach Washington in 2007. *									
				# live larvae from 15 sweeps					
				Small larvae	Medium larvae	Large larvae	Total live & dead larvae from 15 sweeps		
Treatment	Rate		Application method	2 DAT	2 DAT	2 DAT	7 DAT	7 DAT	All dates
DPX-E2Y45	0.066	lb ai/a	CHEMIGATION	5	4	0	13	2	15
BAS320	18.3	fl oz/a	CHEMIGATION	2	5	3	11	13	24
NNI-480	4	oz/a	CHEMIGATION	6	4	0	15	6	22
DIAZINON AG600	2	qt/a	CHEMIGATION	2	1	0	3	3	5
DPX-E2Y45	0.066	lb ai/a	BROADCAST	2	2	0	6	5	12
BAS320	18.3	fl oz/a	BROADCAST	1	1	2	2	4	7
NNI-480	4	oz/a	BROADCAST	1	1	0	3	1	4
DIAZINON AG600	2	qt/a	BROADCAST	1	0	0	0	1	2
CONTROL				4	6	4	15	4	20
LSD (P=.05)				2.2	2.5	2.0	8.3	5.0	10.1
Treatment Prob (F)				0.0001	0.0002	0.002	0.0002	0.0013	0.0004
* Broadcast applied @ 280 gpa with no washoff, chemigation applied @ 280 gpa followed by 680 gpa washoff. Four replications of 10' by 12' plots. Treatments applied 5/9/07.									

Objective 2: Evaluate effective management strategies for priority weed species using new herbicides, adjuvants and application technologies:

<u>New herbicide screening:</u> Several herbicides were screened for efficacy and phytotoxicity. Yellow loosestrife was used as a target weed. These herbicides were selected based on being new reduced-risk products or from previous years' research results. Replicated trials across several sites were conducted at several grower sites. Summary data of efficacy and crop safety are provided in Table 3. Several herbicides caused severe crop damage and are not suitable for cranberries; other had no damage or efficacy. Four potential chemistries include KSU 12800, quinclorac, rimsulfuron and flumiclorac. Based on recent conversations with potential registrants, it is not too likely quinclorac has potential for British Columbia. Others may have potential.

Table 3. Summary of herbicide screening for control of yellow loosestrife and general crop phytotoxicity.

Treatment	Timing	% control	Crop damage
Flumioxazin	Pre	None	None
Isoxaflutole	Pre	None	None
Penoxsulam	Early post	100	Dead
Quinclorac	Early post, two application s	80 to 90	None
Quinclorac	Mid to late post, two application	None	None
Sulfosulfuron	Early post	100	Dead
Flumiclorac	Early post	50 to 80	None to slight
Topramezone	Early post	20	None
KSU 12800	Early post, one application	0 to 100, rate dependent	None to dead
Rimsulfuron	Early post, two applications	50 to 80	None
Mesotrione	Early post, two applications	10 to 20, slight reduction in height	None

Ranunculus, Rubus and Rumex control:

A management strategy for *Rumex cetosella* was assessed by focusing on a combination of dormant season Stinger applications followed by summer Callisto applications. Replicated plots of these treatments were put out at numerous grower sites. Dormant Stinger, if applied post-harvest with additional follow-up applications appears to provide good control of Rumex (Table 4).

Table 4. Effect of Stinger and Callisto for management of *Rumex cetosella* (sour dock) at four cranberry beds in Long Beach, Washington in 2007

Herbicide and application date (s)	% control			
	Site 1	Site 2	Site 3	Site 4
Stinger 10/20 + 1/30		76		
Stinger 10/20 + 1/30 + 3/13	92		91	85
Stinger 10/20 + 1/30 + 3/13; Callisto 4/3 + 5/18	91			88
Stinger 3/12; Callisto 4/6 + 5/18				16
Callisto 4/3 + 5/18 + 6/22	2	56		22
Control	0	0	0	0
Treatment Prob (F)	0.001	0.001	0.001	0.001

A management strategy for using Classic for creeping buttercup (*Ranunculus repens*) control was assessed. Classic was applied in February for mature plant control with subsequent Callisto and Devrinol for seedling control. Although Classic showed excellent efficacy on mature plants (Table 5) without seedling control with either a pre-emergent herbicide (Devrinol) or post-emergent herbicide (Callisto), overall control was lost by then end of the season.

Table 5. Buttercup control using Classic for mature plants and Callisto and Devrinol for seedlings in cranberry beds in Long Beach Washington in 2007.

	% Control		
	Site 1	Site two	
Treatment	8/14/2007	6/22/2007	7/23/2007
Control	0	0	0
Classic @ 0.5oz/ac on 2/22/07	47	70	37
Classic @ 0.5oz/ac on 2/22/07 +Callisto @ 8oz/ac on 6/22/07 & 8/3/07	98	63	80
Classic @ 0.5oz/ac on 2/22/07 + Devrinol 60lb/ac 6/14/07 + Callisto @ 8oz/ac 8/3/07	73	83	93
LSD (P=.05)	62	35	30
Treatment Prob(F)	0.0382	0.0047	0.001

A management strategy for three species of blackberry was assessed using multiple spot treatments of Callisto. Replicated patches of blackberry were treated three times during the season and rated for recovery. All species responded about the same, with Himalayan having slightly more regrowth than cutleaf or creeping blackberry (Table 6). These treatments will continue for several years to determine the length of time required to kill them with Callisto.

Table 6. Effect of three Callisto applications on the recovery of blackberry species in cranberry beds in Long Beach Washington in 2007.*

Blackberry species	% regrowth	% bleaching	% control
Cutleaf blackberry (*R. laciniatus*)	14	18	74
Creeping dewberry (*R. ursinus*)	10	18	66
Himalayan (*R. discolor*)	32	23	67

* Callisto applied 6/7/07, 7/16/07 & 8/9/07 @ 100 gpa spray volume. Plots rated September/October.

<u>Improving the efficacy of Callisto</u>: Callisto lacks efficacy on several recalcitrant weed species, including yellow loosestrife, *Lysimachia terrestris*. Our research in 2006 suggested that it is likely that the cuticle structure of these species prevents herbicide uptake, and that certain surfactants and use of highly concentrated herbicide solutions (ultra-low spray volumes) improve efficacy. We assessed the efficacy of one, two and three applications of Callisto using various high-end surfactants: invert emulsion (Thinvert), silicon hybrid (Kinetic), and a methylated seed

oil with ammonium sulfate (Hasten). Treatments were applied 4/18, 5/19 and 6/18. Only Hasten + ammonium sulfate at three applications was partially effective (Table 7). At least for loosestrife, there doesn't appear to be an easy way to enhance efficacy of Callisto by alternating surfactants.

Table 7. Yellowweed control with various surfactants and multiple timings in a cranberry bed in Long Beach Washington in 2007

	% control			Plant height (in)	% flowering
Treatment	5/25/2007	7/23/2007	8/20/2007	7/23/2007	7/23/2007
Thinvert (99%) 1 application	0	0	0	24	100
Thinvert (99%) 2 applications	5	0	0	17	100
Thinvert (99%) 3 applications	7	3	7	15	50
Kinetic 2 qt/ac 1 application	7	0	0	13	90
Kinetic 2 qt/ac 2 applications	8	10	7	10	0
Kinetic 2 qt/ac 3 applications	18	13	35	10	25
Hasten 2 qt/ac + ammonium sulfate 1 application	22	8	13	13	40
Hasten 2 qt/ac + ammonium sulfate 2 applications	15	3	3	11	23
Hasten 2 qt/ac + ammonium sulfate 3 applications	23	45	68	9	2
LSD (P=.05)	9	17	15	4	28
Treatment Prob(F)	0.0004	0.0022	0.0001	0.0001	0.0001

Effective herbicides and delivery systems for annual weeds and late season grasses. The efficacy of Select herbicide for late season management of barnyard grass, perennial ryegrass and creeping bentgrass was assessed using different surfactants and spray volumes. The differences between Select and Select Max were subtle and not consistent between sites or grass species (Table 8). Similarly, the effects of surfactants were subtle. Adding ammonium sulfate (Kicker plus) to a crop oil (Agridex) increased phytotoxicity. A nonionic surfactant (R11 or X77) didn't appear to be any less phytotoxic than a crop oil to improve efficacy. More than one application was needed to control perennial grasses treated mid-season. Treating perennial ryegrass with Select @ 12 gpa or 100 gpa did not result in any difference in treatment efficacy (data not shown).

Table 8. Efficacy and phytotoxicity of grass herbicides in cranberry beds in Long Beach WA in 2007.*

		Creeping bentgrass		Perennial ryegrass		Barnyard grass	Cranberry	
		Control rating 1=none, 5=good		% control	Control rating 1=none 5=good	Burndown rating 1=none; 5=100%	Phytotoxicity rating 1=none; 5=dead	
		Number of Applications					One application	Two applications
		One	Two	One	Two		Site one	Site two
Treatment	Rate							
Control		1	1	0	1	1	1	1
Select Max X77	16fl oz/a 0.25% v/v	1	5	56.7	4	2.8	1	1
Select Max R11	16fl oz/a 0.25% v/v	1	4	48.3	4	2.8	1	1.7
Select Max Agridex	16fl oz/a 1% v/v	1	4	55	4	3.8	1.07	1.3
Select Max Agridex Kicker Plus	16fl oz/a 1% v/v 1qt/a	1	4.3	72	3		1.67	1
Select Agridex	8fl oz/a 1% v/v	1	3	46.7	3.3	3.3	1.17	1.3
Select X77	8fl oz/a 0.25% v/v	1	1.3	39.8	4.3	3.5	1.17	1
Select X77 Kicker Plus	8fl oz/a 0.25% v/v 1qt/a	1	4	67.3	4		2.1	1
Select	8fl oz/a	1	5	39.8	4	3.5	1.17	1

Agridex	0.5% v/v							
LSD (P=.05)			1.1	34.9	17	1	0.2	0.6
Treatment Prob(F)		ns	0.001	0.026	0.0001	0.0001	0.0001	0.1544

*Treatments were applied in early August with 100 gpa spray volume and evaluated in 30+ days after treatment.