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Progress Report for 2014

Evaluation of new cranberry varieties for the Pacific Northwest

Project No.: Continuing 13C-4127-1329

Title: Cranberry Varieties Trials

Year initiated: 2003 **Current year:** 2014 **Terminating year:** 2020

Personnel: Kim D. Patten, WSU-Long Beach REU, Extension Professor, pattenk@wsu.edu

Title: Cranberry Varieties Trials

Justification:

As cranberry growers plant new acreage or replant existing beds, they want to select varieties that are 1) adapted to the growing region, and 2) high-yielding. Selecting a variety (or varieties) with pest resistance or some level of tolerance may also reduce the overall requirements for pesticides and hence lower the cost of production and increase return per acre. Besides yield, the suitability of a variety for the fresh fruit market is a very important criterion for many growers in Grayland. The goal of this project is to evaluate genotypes for low levels of field and storage rot with good yield and ease of dry harvesting.

Objectives:

1. Maintain the three variety plantings on the Pacific Coast Cranberry Research Farm.
2. Gather data on yield, fruit quality, vigor, disease resistance and overall performance.

Results:

Objective 1) Maintain the new replicated plantings on the Pacific Coast Cranberry Research Farm in Long Beach with 9 new genotypes and 2 standard varieties.
New replicated trials were established at PCCRF in 2009 (39 selections) and 2010 (10 selections), and in Bandon in 2009 (36 selections). These plantings are being maintained.

Objective 2) Gather data on variety performance.
An irrigation system failure in May during mid-20's temperatures resulted in major crop loss to the research plots in 2014. The 2009 and 2010 planting in bed 6 also had significant deer foraging that further reduced yield in 2013 and 2014. Yield and field rot at harvest data have been collected. Storage rot data and fruit quality data are still being collected.

Washington 2009/2010 plantings: Deer predation before harvest affected the 2014 yield from these trials. Because these trials have never had fungicides the percent field rot for these plantings is very high. Some selections were very susceptible to rot, including Crimson Queen, Stevens, Grygleski 1, BG's, Rutgers 1 and Rutgers 2. Some numbered selections had low field and storage rot. These are the same selections that have had low rot in all years of the study and in similar trials in New Jersey. This confirms a genetic component to fruit rot resistance.

Oregon 2009 planting: Several selections went above 600 bbl/ac (Table 4). All the named varieties were in the 350 to 450 bbl/ac range, except Yellow River (350 bbl/ac) and Pilgrim (490 bbl/ac). The two selections scheduled for release in 2014 did well (Rutgers 1 (Welker) & Rutgers 2 (Hains). The average of three years was highest for Rutgers 1. Field rot and 6 weeks storage rot results suggest that Grygleski 1 and Yellow River are decent, but Crimson Queen and Rutgers 1 (Welker) should not be considered for fresh fruit. Rutgers 6 looks good with low field and storage rot for both 2013 and 2014; it may be an option for fresh fruit.

Discussion: Several of the new selections offer growers good opportunities to obtain high yields.   For processed fruit, yield should be the prime determinate of selection of a new variety. For fresh fruit other variables need to be considered, such as rot and size. Our plots did not receive any fungicides and as a consequence fruit rot was very high. This allowed us to obtain good data on rot potential. Rutgers 1, Rutgers 2 and Crimson Queen all have potential for high field and storage rot. Some selections also had fruit that were too big to consider ideal fresh fruit.

Table 2. WSU-PCCRF 2009 planting: field and storage rot 2012 to 2014												
	2012				2013				2014			
Selection	Field rot @ harvest (%)		6 weeks storage rot (%)		Fruit rot rating*		Field rot at harvest (%)		Yield total (bbl/ac)		Field rot @ harvest (%)	
Stevens	11.6	b	19.2	b-e	4.3	a-d	36.0	a-e	195	c-l	29.1	a-e
Pilgrim	13.2	b	34.3	bcd	3.7	a-g	34.0	a-e	319	a-e	33.5	a-e
Crimson Queen	47.6	a	71.9	a	4.1	a-e	39.5	a-e	258	a-j	34.5	a-e
Mullica Queen	12.2	b	18.3	b-e	2.4	b-h	16.3	de	246	a-k	51.0	a
Demoranville	14.2	b	35.2	bc	2.2	c-h	16.0	de	295	a-g	30.3	a-e
Willapa Red	10.2	b	18.3	b-e	2.6	a-h	24.6	a-e	369	ab	26.3	a-g
Grygleski 1	9.6	b	23.7	b-e	4.0	a-f	39.6	a-e	356	abc	20.9	a-i
BG's	11.2	b	14.1	b-e	4.5	abc	53.8	abc	147	f-l	41.5	abc
Yellow River	4.2	b	12.0	b-e	2.0	d-h	12.7	de	305	a-g	40.2	a-d
NJS95-37	13.3	b	20.2	b-e	4.5	abc	23.2	a-e	181	d-l	10.7	e-i
CNJ93-9-42	8.3	b	26.5	b-e	3.0	a-h	21.8	a-e	311	a-f	18.8	a-i
CNJ-93-11-38	18.5	b	22.1	b-e	3.3	a-h	40.6	a-d	269	a-i	25.6	a-g
CNJ93-21-170	9.1	b	15.0	b-e	3.8	a-g	25.8	a-e	208	b-l	36.2	a-e
CNJ93-21-309	10.3	b	13.0	b-e	3.8	a-g	55.9	a	384	a	18.7	a-i
NJS98-62	19.1	b	38.6	b	2.5	b-h	28.5	a-e	283	a-i	44.8	ab
NJS98-71	11.2	b	21.1	b-e	2.8	a-h	13.7	de	285	a-h	17.8	a-i
NJS98-75	6.8	b	21.3	b-e	5.0	a	33.8	a-e	274	a-i	12.5	c-i
US88-1	2.2	b	12.5	b-e	3.0	a-h	36.5	a-e	342	a-d	19.6	a-i
US88-30	2.7	b	8.4	b-e	1.5	gh	9.7	de	124	h-l	31.2	a-e
US88-68	11.5	b	26.3	b-e			6.0	de	156	e-l	3.8	i
US88-70	9.6	b	25.5	b-e	3.0	a-h	28.1	a-e	79	l	17.9	a-i
US88-79	12.1	b	26.1	b-e	4.5	abc	40.8	a-d	152	f-l	29.7	a-e
US88-116	5.9	b	28.7	b-e	3.0	a-h	24.0	a-e	223	a-l	33.0	a-e
US88-121	13.1	b	20.1	b-e	3.8	a-g	28.7	a-e	146	f-l	41.0	abc
US89-3	2.8	b	2.4	e	1.0	h	7.3	de	97	jkl	27.3	a-f
US93-34	0.5	b	8.5	b-e	1.7	e-h	3.6	e	64	l	5.3	f-i
US94-176	0.9	b	4.7	de	1.6	fgh	9.7	de	99	jkl	4.3	hi
US94-181	7.8	b	5.9	cde	2.9	a-h	22.5	a-e	172	e-l	4.9	ghi
CNJ97-86-45	3.2	b	5.1	cde	4.0	a-f	26.3	a-e	205	b-l	11.7	d-i
CNJ97-86-46	5.1	b	9.0	b-e	3.7	a-g	32.7	a-e	227	a-l	24.1	a-h
CNJ98-153-28	11.3	b	21.5	b-e	3.6	a-g	17.7	cde	180	d-l	17.2	b-i
CNJ98-153-48	10.3	b	16.4	b-e	3.5	a-g	26.2	a-e	84	kl	21.1	a-i
CNJ98-153-56	5.8	b	22.2	b-e	3.8	a-g	31.0	a-e	140	g-l	33.9	a-e
CNJ98-154-20	13.3	b	19.2	b-e	3.5	a-g	39.4	a-e	101	jkl	16.0	b-i
CNJ98-154-26	9.8	b	17.6	b-e	2.4	b-h	54.5	ab	270	a-i	45.9	ab
CNJ98-163-17	18.2	b	29.8	b-e	3.8	a-g	19.4	b-e	119	i-l	43.7	ab
CNJ98-163-42	19.0	b	29.3	b-e	4.7	ab	29.0	a-e	256	a-j	21.3	a-i
CNJ98-164-37	15.9	b	29.2	b-e	2.4	b-h	35.5	a-e	118	i-l	21.9	a-i
Treatment F	3.9		4.2		4.3		3.5		7.1		5.6	
Treatment Prob(F)	0.0001		0.0001		0.0001		0.0001		0.0001		0.0001	

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

*- rating of % field rot 1 week before harvest: 1=none, 2=1-5, 3=5to 10, 4=10-40, 5>40

Table 3. WSU-PCCRF 2010 planting: field and storage rot 2013 and 2014								
	2013			2014				
Selection	Field rot %	Storage rot %		Bbl/ac		Field rot %		
98-21	11.7	9.3	b	233	a	29	ab	
Cnj97-99-9	20.4	7.2	b	130	b	19	bc	
CNJ97-57-13	29.2	17.6	ab	226	a	36	a	
WSU 61	11.7	8.1	b	70	c	11	c	
CNJ99-52-15 (Rutgers 1)	25.2	20.8	ab	311	a	28	ab	
CNJ99-9-25	39.7	29.2	a	252	a	36	a	
CNJ 99-9-96 (Rutgers 2)	20.3	20.8	ab	76	c	15	bc	
CNJ93-21-303	27.4	14.1	ab	205	ab	40	a	
CNJ97-99-20	28.8	16.1	ab	213	ab	23	abc	
LSD (P=.05)	19.0	12.1		45		14		
Treatment F	1.9	3.1		11		4		
Treatment Prob(F)	0.11	0.02		0.0001		0.007		

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

Table 4. Bandon Oregon planting-Rutgers/WSU 2009: yield 2011-2014					
	Yield bbl/ac				
Variety	2011	2012	2013	2014	Mean 2012 to 2014
Crimson Queen	23	553	403	326	427
Demoranville	36	559	419	341	440
Grygleski 1	17	254	369	292	305
Mullica Queen	22	551	426	379	452
Pilgrim	30	398	492	687	526
Scarlet Knight	19	304	353	270	309
Stevens	16	216	374	433	341
Willapa Red	55	469	347	385	400
Yellow River	34	188	229	245	221
Rutgers 1	280	725	532	421	559
Rutgers 2	224	568	367	602	512
Rutgers 3	103	733	494	757	661
Rutgers 4	40	438	482	506	475
Rutgers 5	11	582	467	481	510
Rutgers 6	20	392	399	441	411
Rutgers 7	19	569	602	400	524
Rutgers 8	35	351	337	246	311
Rutgers 9	27	564	482	490	523
Lsd 0.05	51	210	168	90	

Table 5. Bandon Oregon planting-Rutgers /WSU 2013 and 2014 Field and 6 weeks storage rot.

Selection	2013				2014			
	Field rot %		Storage rot %		Field rot %		Storage rot %	
Crimson Queen	13	A-d	18	Ab	17	A-d	68	Ab
Mullica Queen	8	A-g	3	Fgh	5	B-i	26	C-g
Demoranville	10	A-f	6	B-h	5	B-i	19	D-g
Stevens	8	A-g	10	A-f	7	B-i	38	A-f
Grygleski 1	3	E-i	7	A-h	2	Hi	10	Fg
Pilgrim	6	A-i	7	A-h	9	B-i	20	C-g
Willapa red	11	A-e	4	D-h	3	E-i	18	D-g
Yellow river	2	Hi	3	E-h	2	Ghi	14	Efg
Scarlet Knight	8	A-g	5	D-h	2	F-i	20	C-g
Rutgers 1	14	Abc	14	A-d	20	Ab	72	A
Rutgers 2	12	A-d	12	A-e	4	D-i	38	A-f
Rutgers 3	4	D-i	4	D-h	7	B-i	30	B-g
Rutgers 4	7	A-i	5	B-h	4	E-i	23	C-g
Rutgers 5	5	C-i	4	E-h	4	C-i	23	C-g
Rutgers 6	3	F-i	2	Gh	1	I	12	Efg
Rutgers 7	7	A-i	6	B-h	11	B-h	36	A-f
Rutgers 8	6	b-i	7	a-h	6	b-i	39	a-e

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

Project Proposal for 2015

Cranberry Varieties Trials

Project No.: Continuing 13C-4127-1329

Title: Cranberry Varieties Trials

Personnel: Kim D. Patten, WSU-Long Beach Research and Extension Unit, Extension Professor

Year initiated: 2003 **Current year:** 2015 **Terminating year:** 2015

Title: Cranberry Varieties Trials

Justification:

Replanting existing unproductive beds with a high yielding profitable variety is one of the key tools a grower has to achieve long term sustainability. Selecting a variety that takes fewer years to reach full production might help growers recover their investments in new and/or replanted beds. While consistent year-to-year high yields are important, so are the reactions to insect pests and diseases. Data over the past 8 years suggest that the newly released germplasm is also less susceptible to yield decline due to cooler weather.

Our 2009 and 2010 variety trials are just now coming into full production. These side by side variety comparisons are critical to determining suitability for Washington growing conditions. The goal of this project is to evaluate genotypes for early production, plant vigor and health, field and storage rot, total yield and fruit quality, and the potential for fresh fruit production.

Objectives:

1. Maintain the five variety plantings: 1) 2009 planting with 29 selections and 10 standard varieties; 2) 2010 planting with 9 selections; 3) 1/3 acre propagation beds of genetically pure Stevens, Pilgrim and Willapa Red, and 4) 2009 planting with 36 selections in Bandon OR, 2012 planting of ¼ acre of Rutgers 1, Rutgers 2, Willapa Red.

2. Gather data on yield, disease resistance, and fruit quality.

Procedures:

Objective 1) Field plantings were previously established in 2009 (WA and OR), 2010 (WA), 2012 (WA) and 2014 (OR) in cooperation with Rutgers University. These will be maintained, fertilized, weeded, and data collected using standard practices.

Objective 2) Yield, fruit size, field and storage rot, growth, disease resistance and other data will be gathered during the 2015 growing season for all variety trials.

Anticipated benefits and information transfer:

Information generated by this research project will be provided to cranberry growers in the region (Washington, Oregon and British Columbia) in a number of ways, including newsletters, field days, grower workshops, extension publications, etc. The information will be shared with other research and extension workers at regional and national meetings and the publication of journal articles.

Budget:

Amount allocated by Commission for 2014: $2,600

Request for FY 2015.

Category	**2015**
Wages	$1,800
Benefits at 9.5%	180
Goods & services	520
Travel	100
Total	**$2,600**

Progress Report for 2014

Weed and other pest control systems for cranberries

Project No: Continuing 13C-4127-1328

Title: Weed and other pest control systems for cranberries

Year Initiated: 1991 **Current Year:** 2014 **Terminating Year:** 2020

Personnel: Kim D. Patten, WSU-Long Beach REU, Extension Professor pattenk@wsu.edu

Justification:
Numerous weeds and insects continue to plague cranberry growers in Washington. To alleviate the damage from these pests, it is critical that new pesticides continue to be registered. To achieve this end, research is needed to evaluate new pesticides for efficacy and crop phytotoxicity, as well fine-tune the rates and timings needed for use by the industry.

Objectives:

Develop and evaluate a tipworm monitoring system

Evaluate biological and chemical controls options for tipworm

Evaluate biorational insecticides for control of blackheaded fireworm (BHFW):

Evaluate herbicides for control of sheep sorrel, and several perennial rushes and sedges in cranberries.

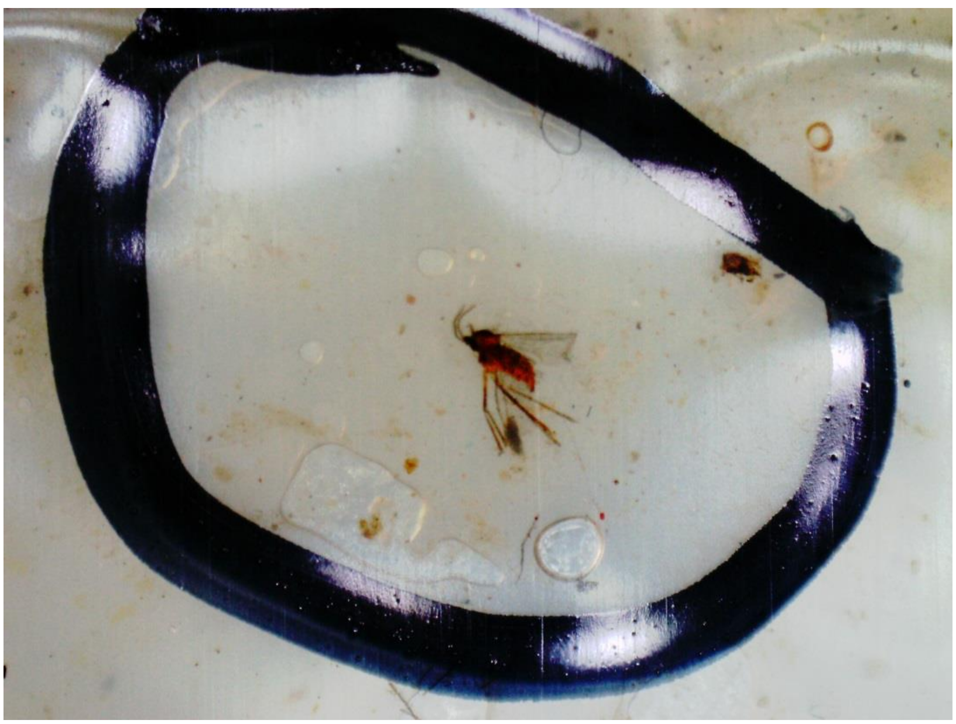
Results:

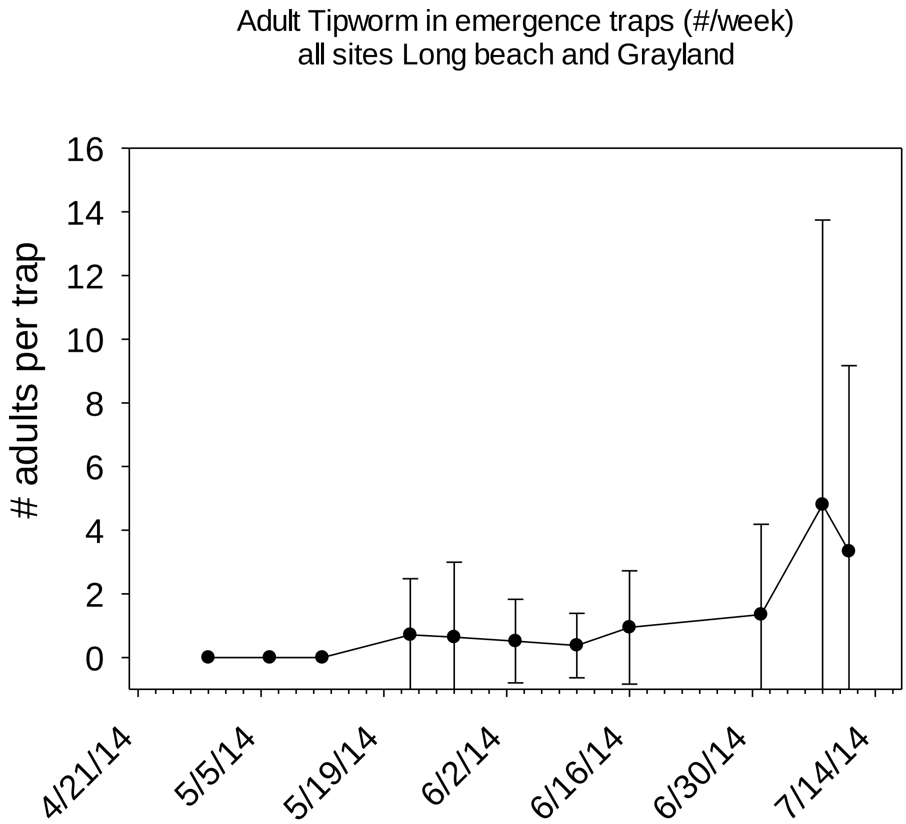
Project Results by Objectives:

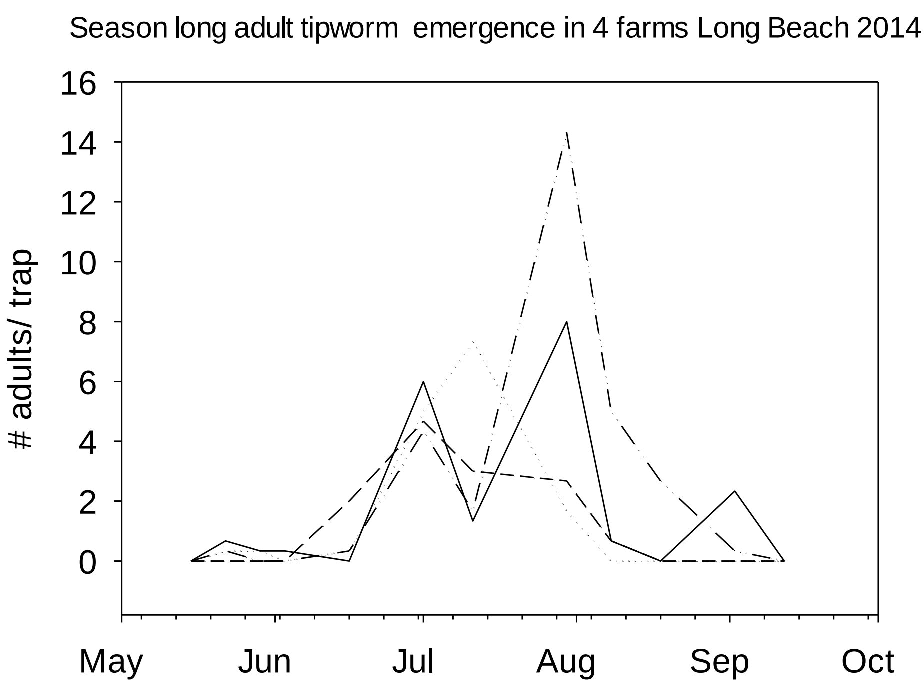
Tipworm monitoring: Tipworm adults were monitored in beds in Grayland and Long Beach using adult emergence traps. They were built by taking empty triple rinsed 2.5 gallon plastic pesticide containers, cutting off the bottom, spraying the inside black, and placing a clear stick film insert on the cap (photos below). These were placed over beds with high infestation and monitored weekly for new adults that got stuck on the cap as they fly toward the light at the top of the container. Traps were moved weekly after each monitoring event. In addition, several beds in Grayland were monitored weekly for the presence of newly curly tips (damage) and new larvae in the tips.

Monitoring results are shown in the graphs below. Emergence data indicate that the traps do work, and provide some relative guidelines of population density and emergence time. However, they are not a very sensitive indicator of emergence of the first generation adults after over-wintering (early to mid-May). Instead, monitoring of tips for first signs of damage (tip curling) or presence of larvae are better indicators. Because newly laid eggs and hatched larvae are so difficult and time-consuming to monitor, using them for an index for when to treat is an untenable option for most small growers.

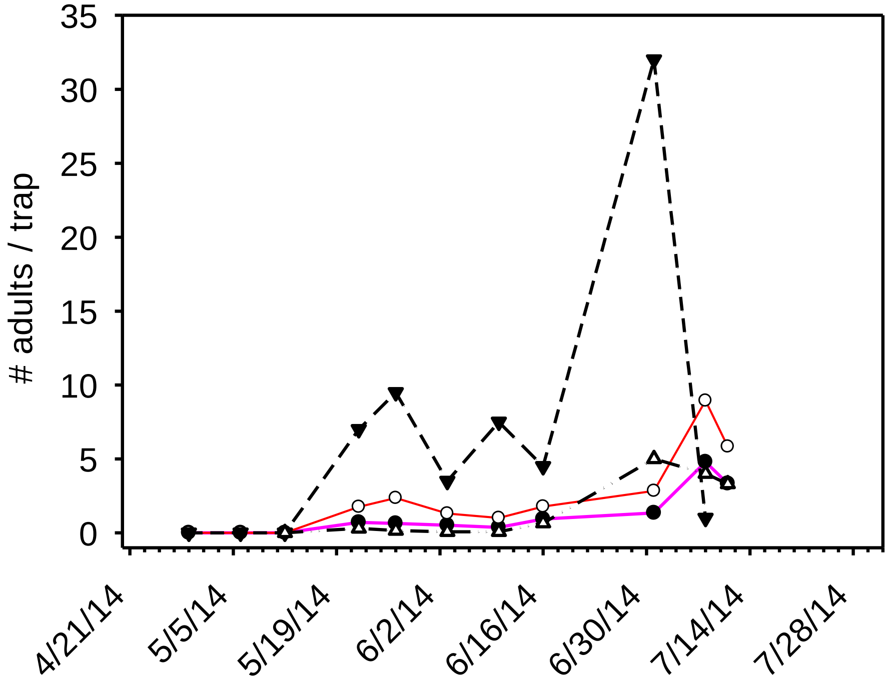
These monitoring data indicate that overall, the first presence of damaged tips on a bed is an easy method that can be adopted by growers for timing sprays to control first generation larvae.



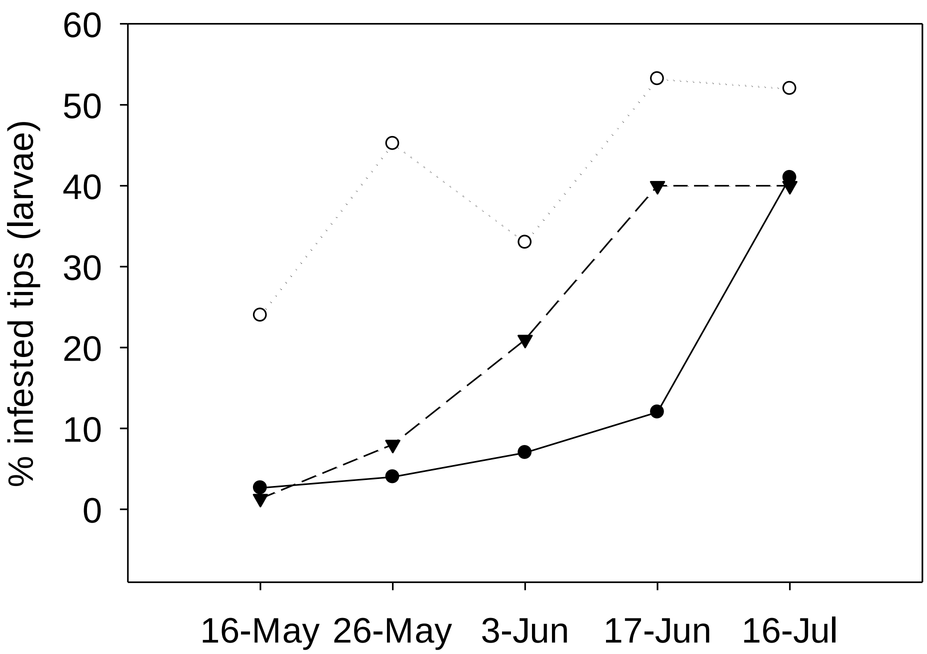

Adult Tipworm in emergence traps (#/week)
all sites Long beach and Grayland
adults per trap
0
2
4
6
8
10
12
14
16
4/21/14
5/5/14
5/19/14
6/2/14
6/16/14
6/30/14
7/14/14

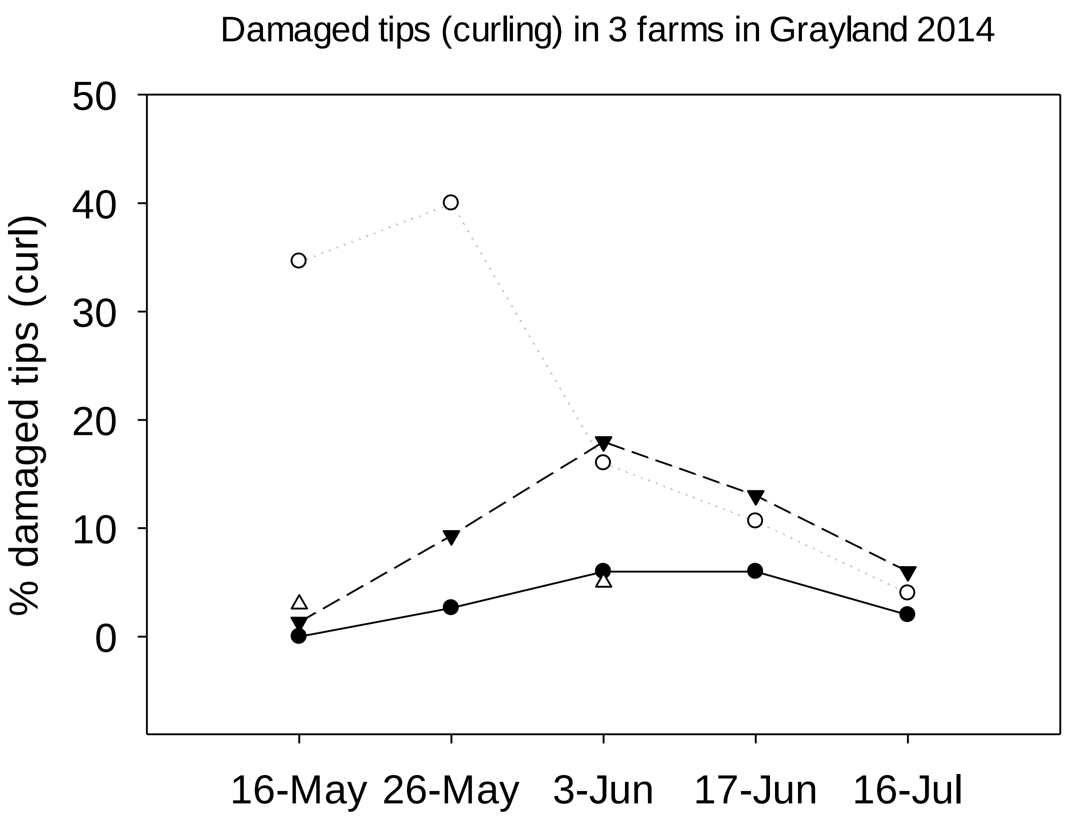

Season long adult tipworm emergence in 4 farms Long Beach 2014
adults/ trap
0
2
4
6
8
10
12
14
16
May
Jun
Jul
Aug
Sep
Oct

Adult tipworm in emergence traps for 4 farms in Grayland (#/week)



% Infested tips with tipworm larvae in 3 farms in Grayland 2014





Chemical Tipworm control: Replicated field trials were conducted on grower beds to test the efficacy of new and existing chemistries against tipworm. Treatment timings focused on two early season (first generation) treatments. Timing was targeted to egg laying and early larvae stages. Efficacy was based on assessing 25 tips per plot for tipworm larvae and pupae for several generations. For any given chemical, there was a lot of variability in the level of control, based on the farm, the parameter assessed, and the date assessed. Results are presented by chemistry.

- Grandevo: Compared to the untreated control, two applications at 3 lb/a showed no control at Farm 1 (Table 1), reduced cupped tips and early larvae at Farm 2 (Table 2), and no control at Farm 3 (Table 3).
- Venerate: Compared to the untreated control, two applications at 8 qt/ac showed no control at Farm 1 (Table 1), reduced cupped tips and early larvae at Farm 2 (Table 2), and no control at Farm 3 (Table 3).
- Altacor: Compared to the untreated control, two applications at 4 oz/ac showed no control at Farm 1 (Table 1) reduced cupped tips and total tipworm at Farm 2 (Table 2), no control at Farm 3 (Table 3), and no control in Farms 5 & 6 (Table 5).
- Altacor + Delegate (6 oz/a): Compared to the untreated control, two applications of this combination showed no control at Farm 1 (Table 1), reduced cupped tips and early larvae at Farm 2 (Table 2), and no control at Farm 3 (Table 3). It did not improve the control over Altacor alone.

- Sevin XLR: Compared to the untreated control, two applications at 2 qt/ac showed a trend for tipworm control at Farm 1 (Table 1), reduced cupped tips and total tipworm at Farm 2 (Table 2), a trend for reduced cupped tips and total tipworm Farm 3 (Table 3), and reduced cupped tips and tipworm in Farms 5 & 6 (Tables 5, 6 &7). The control in Farms 5 and 6, from two May treatments, extended into mid-July (Table 6).
- Pyganic: Compared to the untreated control, two application of Pyganic showed no control at Farm 1 (Table 1), reduced cupped tips and early larvae at Farm 2 (Table 2), and no control at Farms 3, 5 or 6 (Tables 3 & 5).
- Bifenthrin: Compared to the untreated control, two applications showed no control at Farm 3 (Table 1), and excellent short and long term control at Farms 5 and 6 (Tables 5, 6 &7).
- Cyazapyr: Compared to the untreated control, two applications at 20.5 oz/ac showed no control at Farms 4, 5 or 6 (Tables 4, 5, 6 & 7), reduced cupped tips and early larvae at Farm 2 (Table 2), and no control at Farm 3 (Table 3).
- IKI-3106: Compared to the untreated control, one application at 22 fl oz/ac showed no efficacy at Farm 4 (Table 4).

To assure that treatments did not affect yield, crop production was assessed on two farms. There was no treatment effect on yield (Table 8).

In summary, across all times, studies and farms, Sevin and bifenthrin provided the greatest and most consistent efficacy. Grandevo, Venerate, Altacor and Pyganic all showed some moderate efficacy on beds when tipworm applications were timed for the early larval stage. Treatments made after larvae had pupated (Farm 3) failed to provide any efficacy, regardless of chemistry. Cyazapyr, which showed efficacy in 2013 studies, did not show control in 2014 studies. IKI-3106 showed no efficacy, but there were not enough trials conducted to make any definitive inference. Based on these studies, two well-timed applications of Sevin or bifenthrin to control first generation tipworm prior to bloom could provide reasonable suppression of subsequent generations of tipworm populations and their effects on cranberry apical meristems.

Table 1. Insecticide efficacy for first generation tipworm control in 2014 (Experiment 1, Farm 1).								
	#/ 25 uprights							
	Cupped tips	Larvae	Pupae	Total tipworm	Cupped tips	Larvae	Pupae	Total tipworm
Treatment	6/3/2014				6/17/2014			
Control	7	2.3	1.7	3.7	6.7	1.3	3.9	5.3
Grandevo 3 lb/a	6.3	1	3.3	3.9	11.3	1.8	7.9	10.7
Venerate 8 qt/a	8.7	2.3	3.3	5.5	7	2.6	3.5	6.7
Altacor 4 oz/a	7.7	1.3	5	6.3	9	0.7	7.7	9
Altacor 4 oz/a + Delegate 6 oz/a	7.3	2	3.3	5.2	8	1.1	5.5	7
Sevin XLR 2 qt/a	6.7	1	1.7	2.5	10	1.9	5.5	7.7
Pyganic 2 qt/a	10.3	4.3	5.3	9.4	11.3	0.3	11.5	12
LSD (0.05)	4.49	2.23	4.32	0.87	4.15	0.48t	0.70t	4.24
Treatment Prob(F)	0.5	0.08	0.4	0.07	0.1	0.4	0.01	0.05

Applied 5/27/14 and 6/3/14 at 25 gpa, 6’ by 6’ plots, 3 replications.

Table 2. Insecticide efficacy for first generation tipworm control in 2014 (Experiment 1, Farm 2).								
	#/ 25 uprights							
	Cupped tips	Larvae	Pupae	Total tipworm	Cupped tips	Larvae	Pupae	Total tipworm
Treatment	6/11/2014 7 DAT				6/17/2014 14 DAT			
Control	11.1	9.5	0.3	10.1	13.3	1.8	8.7	11.1
Grandevo 3 lb/a	6.3	2.3	0	2.3	7	0	5	5
Venerate 8 qt/a	5.8	2.6	0.6	3.2	8.3	1	4.3	7.1
Altacor 4 oz/a	5	1.5	0	1.7	6.3	0.2	3.3	3.6
Altacor 4 oz/a + Delegate 6 oz/a	6.1	2.2	0	2.5	6	0	3.7	3.6
Sevin XLR 2 qt/a	2.2	0.8	0	0.9	6.3	0.1	2.7	2.8
Pyganic 2 qt/a	2.7	1.3	0.3	1.6	7.7	1.3	2.7	4.6
LSD (0.05)	0.90	0.40	0.21	1.1	3.3	10.82	3.82	1.00
Treatment Prob(F)	0.02	0.05	0.33	0.02	0.01	0.58	0.06	0.06

Applied 6/3/14 and 6/11/14 at 25 gpa, 6’ by 6’ plots, 3 replications.

Table 3. Insecticide efficacy for early season tipworm control in 2014 (Experiment 1, Farm 3).					
	#/ 25 uprights				
	Cupped tips	Larvae	Pupae	Total tipworm	% control
Treatment	6/17/2013				
Control	10	3.7	2.5	8	
Grandevo 3 lb/a	6.3	3.3	3.2	6.7	32.5
Venerate 8 qt/a	6.3	2.3	4.1	7	31.5
Altacor 4 oz/a	5.7	1.7	4.3	6.3	28.9
Altacor 4 oz/a + Delegate 6 oz/a	4	3	1.4	5.3	28.9
Sevin XLR 2 qt/a	2.3	0.7	0.8	1.7	9.2
Pyganic 2 qt/a	4	1.3	2	3.3	23.9
LSD (0.05)	4.8	2.6	0.5	5.6	0.4
Treatment Prob(F)	0.08	0.2	0.4	0.2	0.1

Applied 5/27/14 and 6/3/14 at 25 gpa, 6' by 6' plots, 3 replications.

Table 4. Insecticide efficacy for mid-season tipworm control in 2014 (Experiment 2, Farm 4).								
	#/ 25 uprights							
	Cupped tips	Larvae	Pupae	Total tipworm	Cupped tips	Larvae	Pupae	Total tipworm
Treatment	6/17/2014				6/25/2014			
Control	8.3	4	4.8	8.8	15.8	0.8	4	4.8
Bifenthrin 6.4 oz/ac 2x 1000 gpa	14.5	2.3	9.3	11.5	16.8	0.8	6.3	7
Cyazapyr 20.5 oz/ac 2x 30 gpa	14.3	1.8	10.5	12.3	15.8	0.5	10.8	11.3
Cyazapyr 20.5 oz/ac 2x 1000 gpa	12	3.5	7.5	11	16.5	1.3	8.3	9.5
IKI-3106 1x 22 fl oz/ac 1x 30 gpa					14.3	1.8	8.5	10.3
Lsd (0.05)	6.8	3.3	7.0	9.1	4.7	1.6	4.8	4.6
Treatment prob(F)	0.2	0.4	0.3	0.8	0.8	0.5	0.08	0.06

1x- applied once, 2x – applied twice, applied 6/10/14 and 6/17/14. Plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 100 gpa.

Table 5. Insecticide efficacy for early season tipworm control in 2014 (Experiment 3, Farms 5 & 6).								
	Farm 5				Farm 6			
	#/ 25 uprights							
	Cupped tips	Larvae	Pupae	Total tipworm	Cupped tips	Larvae	Pupae	Total tipworm
Treatment	6/3/2014							
Control	5.3	4.5	0.8	5.3	1.3	1.5	0.2	1.6
Bifenthrin 6.4 oz/ac 2x	0	0	0	0	0.3	0	0.1	0.1
Altacor 2x	5.3	3.3	0	3.3	1.6	1.3	0.3	0.9
Sevin XLR2 qt/a 2x	2.5	0	0	0	3.1	0	0.2	0.2
Pyganic 3x	4.3	4	0	4	1.8	1.3	0.1	0.8
Cyazapyr 20.5 oz/ac 2x	5	3.3	0.3	3.6	2.1	1	0.3	1.4
Lsd (0.05)	2.1	2.1	0.6	2.0	4.4	1.2	2.9	0.5
Treatment prob(F)	0.0006	0.0008	0.2	0.0002	0.05	0.05	0.8	0.06

2x- applied twice, 3x – applied three times. Bifenthrin, Altacor and Cyazapyr applied 5/6/14 and 5/21/14, Sevin and Pyganic applied 5/6/1, 5/21/14 and 5/27/14. Plots were 6’ by 6’ plots, 4 replications per treatment, treatments applied at 100 gpa.

Table 6. Insecticide efficacy for early season tipworm control in 2014 (Experiment 3, Farm 5).									
	#/ 25 uprights								
	Cupped tips	Larvae	Pupae	Total tipworm	Apical bud	Cupped tips	Larvae	Pupae	Total tipworm
Treatment	6/17/2014				7/16/2014				
Control	9.4	3.3	4	7.7	13.5	10	1	2	3.8
Bifenthrin 6.4 oz/ac 2x	0.2	0	0.2	0.2	19	1.5	0	1	0.5
Sevin XLR 2 qt/a 3x	1.4	0.3	0	0.2	20	2.3	0.6	0	1.8
Cyazapyr 20.5 oz/ac 2x	9.2	3.5	4.8	8.6					
Lsd (0.05)	0.18	1.8	0.3	0.25	4.2	3.0	0.4	2	3.5
Treatment prob(F)	0.0001	0.002	0.0005	0.0001	0.01	0.0008	0.3	0	0.1

2x- applied twice, 3x – applied three times. Bifenthrin and Cyazapyr applied 5/6/14 and 5/21/14, Sevin applied 5/6/1, 5/21/14 and 5/27/14. . Plots were 6’ by 6’ plots, 4 replications per treatment, treatments applied at 100 gpa.

Table 7. Insecticide efficacy for early season tipworm control in 2014 (Farm 6).									
	#/ 25 uprights								
	Cupped tips	Larvae	Pupae	Total tipworm	Apical bud	Cupped tips	Larvae	Pupae	Total tipworm
Treatment	6/17/2014				7/16/2014				
Control	2.6	0.8	1.6	2.5	7.3	10.3	0.7	4.6	4.8
Bifenthrin 2x	0.1	0	0	0	7	2.3	0	0.6	0.6
Sevin XLR 3x	1.4	0.4	0.1	0.6	7	9.5	1	1.7	2.2
Cyazapyr 20.5 oz/a 2x	2.6	2.3	1.1	3.7					
Lsd (0.05)	7.3	6.7	7.8	9.6	4.8	6.7	2.3	0.4	0.5
Treatment Prob(F)	0.11	0.08	0.19	0.1	0.9	0.05	0.5	0.05	0.07

2x- applied twice, 3x – applied three times. Bifenthrin and Cyazapyr applied 5/6/14 and 5/21/14, Sevin applied 5/6/1, 5/21/14 and 5/27/14. Plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 100 gpa.

Table 8. Effect of cranberry tipworm control insecticides on yield (Farms 6 & 9).		
	Yield (bbl/ac)	
Treatment	Farm 6	Farm 8
Control	105.8	80.9
Bifenthrin 6.4 oz/ac 2x	145.8	80.3
Altacor 2x	119.0	72.2
Sevin XLR2 qt/a 2x	103.7	80.0
Pyganic 3x	135.4	75.2
Cyazapyr 20.5 oz/ac 2x	95.4	78.1
Lsd (0.05)	45.0	39.0
Treatment Prob (F)	0.2	1.0

2x- applied twice, 3x – applied three times. Bifenthrin and Cyazapyr applied 5/6/14 and 5/21/14, Sevin applied 5/6/1, 5/21/14 and 5/27/14. Plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 100 gpa.

Biocontrol of Tipworm: Trials were conducted to assess biocontrol options for Tipworm. *Metarhizium anisopliae* strain F52 (MET 52G formulation) was applied in the winter and efficacy assessed with emergence traps. There was no difference in emergence populations between treated and untreated plots.

Biorational insecticides for control of blackheaded fireworm: Replicated field trials were conducted on grower beds to test the efficacy of new and existing chemistries against fireworm. Treatment timings focused on first and second generations. Efficacy was based on assessing 5 sweeps per plot. Results are presented by chemistry.

- Altacor: Compared to the untreated control, one early application of Altacor at 4 oz/ac provided 100% control of first generation fireworm at 5 and 13 days after treatment (Tables 9 and 10).
- Grandevo: Compared to the untreated control, two applications at 3 lb/a provided 25% control of first and second generation fireworm (Tables 9, 10, 11 & 12).
- Venerate: Compared to the untreated control, two applications at 2 gal/a showed good control of first generation fireworm (86%), but only 37% control of second generation larvae (Tables 9, 10 11 & 12). Control for both generations took 11+ days before it was expressed.
- Bifenthrin: Compared to the untreated control, one application at 6.4 oz/a provided 100% control of first generation fireworm at 5 and 13 days after treatment (Tables 9 and 10).
- IKI-3106: Compared to the untreated control, one application at 22 fl oz/a provided almost 100 % control of first generation fireworm at 5 and 13 days after treatment (Tables 9 and 10).
- Entrust: Compared to the untreated control, one application at 6 oz/a provided 87% control of second generation fireworm at both 4 and 8 days after treatment assessments (Tables 11 & 12). Less control was noted with small larvae than medium or large larvae.
- Pyganic: Compared to the untreated control, one application at 2 qt/a provided ~87% control of second generation fireworm at both 4 and 8 days after treatment assessments (Tables 11 & 12). Less control was noted with small larvae than medium or large larvae.
- DiPel: Compared to the untreated control, one application at 1 lb/a provided ~ 50% control of second generation fireworm at both 4 and 8 days after treatment assessments (Table 11 & 12).

In summary, Altacor, bifenthrin and IKI-3106 all provided excellent control (>99%), Entrust and Pyganic provided good control of fireworm (~ 80 – 90%), and Grandevo, Venerate, and DiPel provided moderate efficacy (~ 50%) against fireworm. The grower standard, Altacor, is an exceptionally efficacious chemistry for fireworm. Registration of new chemistries, like bifenthrin and IKI-3106, would help with resistance management. Entrust, Pyganic, Grandevo, Venerate, and DiPel are all considered soft chemistries and all are certified for organic use. Both Entrust and Pyganic would provide good control. Growers using Grandevo, Venerate, or DiPel would need to carefully monitor their beds to assure damage levels were maintained below economic threshold levels.

Table 9. Insecticide efficacy for first generation fireworm control in 2014 at five days post treatment (Farm 7).								
	# of fireworm larvae per 5 sweeps on 5/7/2014							
	Small		Medium		Large		Total	
Treatment	Alive	Dead	Alive	Dead	Alive	Dead	Total	Alive
Control	1.4	0.1	5.4	0	2.9	0	10.9	10.6
Altacor 4 oz/a 1x	0.3	1.3	0.1	1.6	0	0	4.9	0.6
Grandevo 3 lb/a 2x	1.4	0.2	3.7	0.2	3.4	0.3	11.8	10
Venerate 2 gal/a 2x	0.5	0.2	1.2	0	2.2	0	5.4	4.3
Bifenthrin 6.4 oz/a 1x	0	0	0	0	0	0	0.3	0.1
IKI-3106 22 fl oz/a 1x	0	0.1	0	0.6	0.2	0	1	0.1
LSD (0.05)	4.3	4.2	5.3	0.3	0.3	0	7.5	7.5
Treatment Prob(F)	0.01	0.1	0.0001	0.04	0.0001	1	0.0003	0.0001

1x- applied once, 2x – applied twice. All products applied 5/2/14, with Grandevo and Venerate plots getting a second application 5/7/14. Plots were 6’ by 7’ plots, 6 replications per treatment, treatments applied at 100 gpa.

Table 10. Insecticide efficacy for first generation fireworm control in 2014 at two weeks post treatment (Farm 7).								
	# of fireworm larvae per 5 sweep on 5/15/2014							
	Small		Medium		Large		Total	
Treatment	Alive	Dead	Alive	Dead	Alive	Dead	Total	Alive
Control	0	0.5	1.8	0	4	0	6.5	6
Altacor 4 oz/a 1x	0	0	0	0	0	0	0	0
Grandevo 3 lb/a 2x	0.3	0	0.7	0	1.5	0	2.5	2.5
Venerate 2 gal/a 2x	0	0	0	0	1	0	0.9	0.9
Bifenthrin 6.4 oz/a 1x		0	0	0	0	0	0	0
IKI-3106 22 fl oz/a 1x	0	0	0	0	0	0	0	0
Lsd (0.05)	0	0	3.9	0	1.2	0	0.2	0.2
Treatment Prob(F)	1	1	0.002	1	0.0001	1	0.0001	0.0001

1x- applied once, 2x – applied twice. All products applied 5/2/14, with Grandevo and Venerate plots getting a second application 5/7/14. Plots were 6’ by 7’ plots, 6 replications per treatment, treatments applied at 100 gpa.

Table 11. Insecticide efficacy for second generation fireworm control in 2014 at two week post treatment (Farm 8).								
Treatment	# of fireworm larvae per 5 sweep on 7/7/2014							
	Small		Medium		Large		Total	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
Control	8.5	0	18.5	0	16.7	0	43.8	0
Entrust SC (6 oz/a)	5.5	7.6	0.8	1.8	0.1	0	6.5	9.4
Pyganic (2 qt/a)	2.8	2.4	2.3	2.5	0.3	0.3	5.5	7.5
Grandevo (3 lb/a)	11	0.8	9.8	1.4	1.7	0.3	23	2.8
Venerate (8 qt/a)	10.8	0.3	18.3	1.6	12.1	0	41.3	1.9
DiPel (1 lb/a)	12.5	0.3	12.3	1.6	0.5	0	25.8	1.9
LSD (0.05)	8.9	0.5	4.3	0.5	5.8	0.4	12	0.5
Treatment Prob(F)	0.27	0.01	0.0001	0.3	0.0001	0.5	0.0001	0.004

Applied 7/3/14, plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 30 gpa.

Table 12. Insecticide efficacy for second generation fireworm control in 2014 at one week post treatment (Farm 8).								
Treatment	# of fireworm larvae per 5 sweep on 7/11/2014							
	Small		Medium		Large		Total	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
Control	8.5	0	16	0	15.4	0	40	0
Entrust SC (6 oz/a)	3	0	1.8	0.8	0.1	0	5.3	0.8
Pyganic (2 qt/a)	4	0	2.7	0.5	0.3	0	6.9	0.5
Grandevo (3 lb/a)	5	0	8.1	0.3	3.2	0	16.1	1
Venerate (8 qt/a)	6.5	0	12.1	0	7	0	24.9	0.5
DiPel (1 lb/a)	15.3	0	8.6	0	5.9	0	29.2	0
LSD (0.05)	5.9	0	0.3	1.08	4.4	0	0.3	1.6
Treatment Prob(F)	0.006	1	0.002	0.5	0.0001	1	0.0001	0.7

Applied 7/3/14, plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 30 gpa.

Table 13. Insecticide efficacy for second generation fireworm control in 2014, using chemigation spray volumes (Farm 8).								
	# of fireworm larvae per 5 sweep on 7/17/2014							
	Small		Medium		Large		Total	
Treatment	Alive	Dead	Alive	Dead	Alive	Dead	Total	Alive
Control	2.1	0	4.3	0	4	0	9.3	7.6
Bifenthrin 6.4 oz/a 1x	0.0	0.5	0.0	1.6	0	0	0.9	0.6
IKI 3106 22 fl oz/a 1x	0.1	1.3	0.1	0.2	0	0	1.6	0.8
LSD (0.05)	10	2.8	8.9	6.2	0	0	0.7	0.6
Treatment Prob(F)	ns	ns	0.02	ns	ns	ns	0.08	0.02

1x- applied once, All products applied 7/14/14.. Plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 1000 gpa.

Evaluate herbicides for control of sheep sorrel, and several other problematic cranberry weeds:

Sheep sorrel: Multiple stinger applications, Casoron or stinger plus Casoron all suppressed sheep sorrel in the spring, but by midsummer there was no difference between treatments; however, numerically they had lower percent bloom (Table 14).

*Lotus: S*ummer-applied Stinger, Callisto +Curio, Callisto + Quinstar, or Callisto + Curio + Quinstar and elemental sulfur all controlled Lotus in the year following treatment (Table 15). No follow-up was made on crop phytotoxicity, however. Fall-applied Stinger or Stinger + Curio controlled Lotus in the year after treatment (Table 16).

Table 14. Effect of various herbicide treatments of sheep sorrel control in 2014						
	Sheep sorrel					
	% cover		% cover		% in bloom	
Treatment	4/14/2014		7/28/2014		7/28/2014	
Control	75	a	91	a	44	a
Stinger 10.7oz/ac on 11/14/13, 1/3/14 and 2/21/14	15	b	92	a	15	a
Casoron 50 #/a 11/18/13 + 30#/a 3/13/14	10	b	99	a	16	a
Casoron 50 #/a 3/11/14 + 30 #/a 3/31/14	1	b	93	a	2	a
Stinger 10.7oz/ac on 11/14/13, 1/3/14 and 2/21/14 + 'Casoron 50 #/a 11/14/13 + 30 #/a 3/31/14	2	b	98	a	10	a
Stinger 10.7oz/ac on 11/14/13, 1/3/14 and 2/21/14 + 2,4-d G 20 #/a 3/13	3	b	93	a	9	a
Casoron 50 #/a 11/14/13 +30 #/a 3/31/14+2,4-d G 20 #/a 3/13	6	b	60	a	7	a
Treatment ProbF)	0.0001		0.37		0.18	
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)						

Table 15. Effects of late summer-applied herbicides in 2013 on Lotus control in 2014.		
Treatment	% lotus cover 7/28/2014	
Control	61.1	a
Callisto 8 oz/a + Curio 1 oz/a	22.2	ab
Stinger 8 oz/a	13.1	ab
Callisto 8 oz/a + Curio 1 oz/a + Quinstar 8 oz/a	6.4	ab
Callisto 8 oz/a + Quinstar 8 oz/a	2.7	b
Sulfur 500 #/a	7.7	ab
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls). Treatments applied 8/20/13, treatments with Callisto used 0.25% x 77 as a surfactant.		

Table 16. Effects of fall-applied herbicides in 2013 on Lotus control in 2014.				
	Lotus % cover			
Treatment	3/26/2014 bed 1		7/21/2014 bed 2	
Control	45	a	95	a
Stinger 10.7 oz/a on 10/30/13	2	a	13	b
Curio 1 oz/a on 10/30/13	43	a	95	a
Stinger 10/7 oz/a + Curio 1 oz/a on 10/30/13	9	a	36	b
treatment prob (f)	0.0322		0.0005	
Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)				

Project Proposal for 2015

Weed and other pest control systems for cranberries

Project No: Continuing 13C-4127-1328

Title: Weed and other pest control systems for cranberries

Year Initiated: 1991 **Current Year:** 2015 **Terminating Year:** 2020

Personnel: Kim Patten, Extension Professor
WSU- Long Beach Research and Extension Unit

Justification:

Numerous weeds and insects continue to plague cranberry growers in Washington. In 2013 and 2014, tipworm in particular was problematic. To alleviate the damage from these pests, it is critical that new pesticides continue to be registered. To achieve this end, research is needed to evaluate new pesticides for efficacy and crop phytotoxicity, as well as to fine-tune the rates and timings needed for use by the industry. In addition, in fall 2014 the EU reduced the MRL of the fungicide chlorothalonil on cranberries for the 2015 harvest from 2 ppb to 0.01 ppb. Because of the global marketing of cranberries, with the exception of the domestic fresh fruit market, this eliminates the use of this critically important fungicide to cranberry growers. The alternatives are one broad spectrum fungicide (Dithane, fungicide group M3), and three single mode of action fungicides, Indar and Proline, fungicide group 3, and Abound, fungicide group 11. With a requirement of at least 5 sprays (2 to 4 for fruit rot and 2 to 3 for twig blight), and multiple pathogenic species, developing an effective disease management program that addresses resistance management becomes critical.

Objectives:

Assess efficacy of the new IPM strategy for cranberry tipworm

Develop and evaluate a chlorothalonil-free fungicide program that addresses the critical disease concerns of the cranberry industry

Procedures:

Objective 1: Assess efficacy of the new IPM strategy for cranberry tipworm. Our research in 2014 developed an IPM protocol for managing tipworm. The easiest timing protocol for first generation spray timing was based on visual observation of the first visual occurrence of upright tip curling. This was more sensitive and consistent than emergence traps. The only effective registered insecticide was carbaryl. In 2015 we will assess the efficacy of a tipworm IPM program. This will be done in 3 ways.

1) Grower whole bed assessments: Five to 10 select growers from across two growing regions will be encouraged to rigorously scout their beds and treat with carbaryl 1 day and 7-10 days after first observed tip curling. Additional sprays for second and third generation suppression will include Altacor. IPM efficacy will be assessed by the level of tip damage resulting from second and third generation infestations and season-long emergence trap data. Comparisons will be made with historic levels and adjacent non-IPM beds.

2) Research plots- carbaryl timing: Replicated research trials will be conducted at two to three locations to assess the most effective use of carbaryl for first generation tipworm control. Five treatment comparisons will be made: untreated control, carbaryl 1 day after first tip curling (DAFTC), carbaryl 1 and 7 DAFTC, carbaryl 1, 7 and 14 DAFTC, and carbaryl 1 and 14 DAFTC. Treatments will be applied in 6' x 8' plots in 4 replications per site. Efficacy will be based on tip assessment for live larvae and pupae.

3) Research plots- new chemistries:
Although carbaryl provided good efficacy, it has MRL and pollinator issues when used during and after bloom, and is not an option for organic growers. Research trials on alternative insecticides will be continued. Comparisons will be a control, bifenthrin, Pyganic, cyazapyr, Altacor and diazinon. Treatments will be applied in 6' x 8' plots in 4 replications per site. There will be three applications 7 days apart with first timing aimed at the second generation, based on visual inspections of egg laying and new larvae. Efficacy will be assessed every 7 days by visual inspection of 25 random upright tips for larvae, pupae and tip damage.

Objective 2: Develop and evaluate a chlorothalonil-free fungicide program that addresses the critical disease concerns of the cranberry industry. In 2015 we will assess the efficacy of various alternative chlorothalonil-free fungicide programs that address efficacy and resistance management for cranberry fruit rot and twig blight. Currently a working group of cranberry plant pathologists from across North America is developing a series of recommendations that will utilize one broad spectrum fungicide, Dithane (fungicide group M3), and three single mode of action fungicides, Indar and Proline, (fungicide group 3) and Abound (fungicide group 11). For west coast cranberries there is a requirement of at least 5 sprays (2 to 4 for fruit rot and 2 to 3 for twig blight), starting early to mid-June and ending in mid to late-July.

Our research will focus on using a broad spectrum fungicide for the final sprays, and different rotations of the single mode of action fungicides for the bloom sprays for fruit rot. There will be 6 treatments. The treatment sequence is pending a consensus from the pathology working group. Treatments will be applied in 6' x 8' plots in 5 replications per site. Treatments will be applied on grower beds with a history of high rots. There will be six sites with 2 locations of 3 varieties, Pilgrim, Stevens and Crimson Queen. Field rot will be assessed at harvest, and keeping quality after 6 weeks of storage. Storage rot will be assessed at 6 weeks. Twig blight infestation will be assessed in the spring 2016, when the disease is expressed. Similar studies will be conducted in other growing regions in North America. Our goal will be to have solid grower recommendations for the 2016 growing season.

Anticipated Benefits and Information Transfer:
Growers will get new products registered for tipworm control, and new control options for their insect and weed problems. Information from these results will be transferred through workshops, the Cranberry Vine newsletter, and field days.

Budget:
Amount allocated by Commission for 2014: $13,737

Request for FY 2015.

Salaries	$7,195
Salaried employee benefits at 40.7%	$2,928
Hourly workers	$840
Hourly benefits	$84
Other (supplies)	$240
Other (equipment)	$2,000
Other (travel to farms and meetings)	$450
TOTAL	**$13,737**

Sources of Support

TITLE OF PROJECT	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL AMOUNT	EFFECTIVE AND EXPIRATION DATES
PATTEN	**Active Grants:**		
Weed and other pest control systems for cranberries	Cranberry Commission	$13,737	5/14 no term date
Cranberry Varieties Trials	Cranberry Commission	$2,600	5/14 no term date
Insecticide screening and pesticide residue minimization for cranberry	Cranberry Institute	$11,990	5/14 to 4/15
Assessment of new pest management tools that address priority needs of the bc cranberry industry	BC Cranberry Growers Association	$15,253	5/14 to 4/15
Extension IPM	USDA, EIPM	10,000	9/14-8/15
Fungal Populations in PNW Cranberries as it relates to fruit rot	USDA, NW Center for Small Fruit Research	$24,437	9/14 to 9/15
Perennial weed and blackheaded fireworm management in PNW cranberries using low-risk alternative pesticides	Washington State Commission on Pesticide Registration	$11,709	1/15 to 12/15
Biology and Management of Spotted Wing Drosophila on Small And Stone fruit	USDA, SCRI	6,412	7/14 to 2/15
	Pending:		
Cranberry Varieties Trials	Washington State Cranberry Commission	$2,600	5/15 no term date
Weed and other pest control systems for cranberries	Washington State Cranberry Commission	$13,737	5/15 no term date
Using Biochar, Base-Cation Saturation Ratio (BCSR) mineral balancing, and commercially available remineralization mixes to increase improve soil quality and production in organic cranberries.	WSU, BioAg	$19,764	5/15-4/16

SUMMARY
BUDGET REQUEST

LAST YEAR FUNDING REQUESTS (2014)

Project No.	Short Title	Lead Scientist	Amount Requested
Project 13C-4127-1328	Weed Control Systems	Patten	$13,737
Project 13C-4127-1329	Cranberry Varieties Trials	Patten	$ 2,600

CURRENT YEAR PROJECTS (2015)

Project No.	Short Title	Lead Scientist	Amount Requested
Project 13C-4127-1328	Weed Control Systems	Patten	$13,737
Project 13C-4127-1329	Cranberry Varieties Trials	Patten	$ 2,600