Surveillance of cranberry fruitworm (*Acrobasis vaccinii*) moths and infested fruit in blueberries and cranberries – 2014

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INTRODUCTION

Cranberry fruitworm (*Acrobasis vaccinii*), a critical fruit-contaminating pest of cranberry and blueberry, was detected in British Columbia in 2011. This lepidopteran is a significant internal fruit pest throughout berry growing regions in eastern United States and Canada.

In 2012, an area-wide monitoring program was initiated to monitor cranberry fruitworm moth flight and to quantify cranberry fruitworm damage in BC blueberry and cranberry fields. Results from 2012 and 2013 indicated that moths were caught in both cranberry and blueberry fields, but the damage to fruit occurred in cranberry only. The 2014 season was the third year of area-wide monitoring for the cranberry fruitworm.

METHODS

Moth surveillance in cranberries

Pheromone traps were placed in 97 cranberry fields on 32 commercial cranberry farms and monitored weekly by E.S. Cropconsult from the week of May 26, 2014 until the week of August 25, 2014 (Table 1). The cranberry fields were located in Richmond, Delta, Langley, Chilliwack, Pitt Meadows and Maple Ridge. Depending on the size of the farm and previous history of cranberry fruitworm (CBFW), one to eight traps were placed per farm, with a maximum of one trap per field. Wingtraps (Contech Delta Trap Product # 300000075) baited with cranberry fruitworm lures (Contech Product # 300000893) were hung on wooden stakes approximately 30-cm above ground-level and positioned so that the openings faced east-west. When multiple traps were hung on the same stake, CBFW traps were paired with cranberry girdler traps and not with sparganothis or blackheaded fireworm traps, in order to minimize any potential pheromone interference. Traps were placed approximately 10m from the field edges. Lures were replaced one time, after six weeks, during the week of July 7, 2014.

Table 1. Cranberry farm locations and number of Cranberry fruitworm traps per farm

Farm #	Farm Name	Location	# traps/ farm
1	Surrey 1	Surrey	2
2	East Delta 1	East Delta	2
3	East Delta 2	East Delta	2
4	West Delta 1	West Delta	7

5	West Delta 2	West Delta	5
6	West Delta 3	West Delta	8
7	South Richmond 1	South Richmond	4
8	South Richmond 2	South Richmond	1
9	South Richmond 3	South Richmond	4
10	South Richmond 4	South Richmond	4
11	South Richmond 5	South Richmond	2
12	North Richmond 1	North Richmond	3
13	North Richmond 2	North Richmond	1
14	North Richmond 3	North Richmond	1
15	North Richmond 4	North Richmond	6
16	North Richmond 5	North Richmond	6
17	North Richmond 6	North Richmond	2
18	North Richmond 7	North Richmond	2
19	North Richmond 8	North Richmond	1
20	Langley 1	Langley	2
21	Langley 2	Langley	5
22	Langley 3	Langley	4
23	Langley 4	Langley	2
24	Langley 6	Langley	1
25	Langley 7	Langley	2
26	Langley 8	Langley	1
27	Langley 9	Langley	2
28	PMMR 1	Pitt Meadows/ Maple Ridge	9
29	PMMR 2	Pitt Meadows	2
30	PMMR 3	Pitt Meadows	2
31	Chilliwack 1	Chilliwack	1
32	Chilliwack 2	Chilliwack	1

Moth traps were checked and maintained once a week. Once moth catches began, sticky inserts containing moths suspected of being CBFW were removed and a new insert was placed in the trap. Inserts with suspect moths were taken to the B.C. Ministry of Agriculture (BCAgri) Plant Health Lab to confirm identifications for the first two weeks of catches. Afterwards, the identification was confirmed by E.S. Cropconsult Ltd. senior staff.

Moth surveillance in blueberries

Pheromone traps were set up in 28 blueberry fields located in Richmond, Delta, Surrey, Langley, Abbotsford, Matsqui, Chilliwack, Port Coquitlam, Pitt Meadows and Maple Ridge (Table 2). Wingtraps were baited with cranberry fruitworm lures (as used in cranberry surveillance) and monitored weekly from the week of May 12, 2014 until the week of August 25, 2014. Pheromone lures were replaced twice at six week intervals, during the weeks of June 23, 2014 and August 4, 2014. Two pheromone traps were placed per field, 50m apart, and hung in blueberry bushes along field edges that were adjacent to hedgerow vegetation. When suspect

moths were caught in traps, sticky inserts were replaced. Inserts with suspect moths were taken to the BCAgri Plant Health Lab to confirm identification.

Table 2. Blueberry farm locations and number of Cranberry fruitworm traps per farm

Farm #	Farm Name	Location	Cultivar	# traps/ field
1	Richmond 1	Richmond	Duke	2
2	Richmond 2	Richmond	Bluecrop	2
3	Ladner 1	Ladner	Duke	2
4	Ladner 2	Ladner	Duke	2
5	Ladner 3	Ladner	Duke	2
6	East Delta 1	East Delta	Bluecrop	2
7	East Delta 2	East Delta	Duke	2
8	Surrey 1	Surrey	Bluecrop	2
9	Surrey 2	Surrey	Bluecrop	2
10	Surrey 3	Surrey	Elliott	2
11	Langley 1	Langley	Duke	2
12	Langley 2	Langley	Elliott	2
13	Langley 3	Langley	Duke	2
14	Abbotsford 1	Abbotsford	Chandler	2
15	Abbotsford 2	Abbotsford	Draper	2
16	Abbotsford 3	Abbotsford	Bluecrop	2
17	Matsqui 1	Matsqui	Duke	2
18	Matsqui 2	Matsqui	Bluecrop	2
19	Matsqui 3	Matsqui	Bluecrop	2
20	Port Coquitlam 1	Port Coquitlam	Bluecrop	2
21	Pitt Meadows 1	Pitt Meadows	Bluecrop	2
22	Pitt Meadows 2	Pitt Meadows	Duke	2
23	Pitt Meadows 3	Pitt Meadows	Duke	2
24	Maple Ridge 1	Maple Ridge	Duke	2
25	Maple Ridge 2	Maple Ridge	Draper	2
26	Chilliwack 1	Chilliwack	Duke	2
27	Chilliwack 2	Chilliwack	Elliott	2
28	Chilliwack 3	Chilliwack	Duke	2

Fruit Damage Assessment in Cranberry

Fruit was sampled for CBFW infestation between June 16, 2014 and August 15, 2014. Fruit was collected from 19 cranberry fields that had positive trap catches, with more frequent collections from fields with successive weeks of trap catches. Approximately 200 berries were collected from a 5m radius around the pheromone trap. Two additional collections of ripening fruit were made from September 5 – 22, 2014. For the September fruit collection, berries were collected from five 30cm^2 locations in 20 fields where CBFW damage was observed or suspected. So, for these late collections, the number of fruit per field varied, but the area sampled per field

remained the same. Fruit was also collected in September from five fields where moths were not caught to determine if CBFW damage was present. Berries were placed in plastic bags and held in the fridge until viewing. Fruit was examined under a dissecting microscope for eggs (hatched, yellow, or dead), larvae, bore holes, or damage.

Fruit Damage Assessment in Blueberry

Green fruit was collected from 5 blueberry fields where CBFW moths were captured in traps. Green fruit was collected between June 16 and July 15, 2014. Approximately 200 green berries were collected per field from a 20m radius around the pheromone traps, and stored in plastic bags in coolers for transport to the lab. Fruit was kept cool to prevent further development of the eggs or larvae until fruit could be assessed. Fruit was then examined under a dissecting microscope for eggs (hatched, yellow, or dead), larvae, bore holes, or frass, and damage, in the same way as for cranberry fruit. A final evaluation of ripe blueberry fruit was done Aug 4-8; 200 fruit were collected and assessed for fruitworm presence or damage from 4 blueberry fields which had moth catches earlier in the summer.

Degree Day Model

The cranberry fruitworm degree day model from Michigan State University (MSU) uses a lower development threshold temperature of 10°C (50°F) and predicts that moth flight will begin approximately $350DD_{50}$ after March 1st (Isaacs and Salazar 2009). The trap check date immediately prior to first sustained moth catch becomes the biofix for this model. Egg laying typically begins $85DD_{50}$ following the biofix date, and continues until $400DD_{50}$ have elapsed (Isaacs and Salazar 2009).

Preliminary evaluation of the CBFW degree day model was carried out using the online Spotted Wing Drosophila (SWD) degree day model developed at Oregon State University (http://uspest.org/risk/models) with temperature data (in Fahrenheit) from the Richmond and Pitt Meadows airports. The start date of the SWD model was changed to March 1st to calculate the degree days to predicted CBFW moth flight. The SWD degree day model uses a single sine wave method to calculate degree days, with the same lower development temperature threshold of 10°C (50°F) as in the cranberry fruitworm degree day model (Coop and Dreves 2013). Because CBFW pheromone traps were checked weekly, biofix for the cranberry fruitworm degree day calculations was set as seven days before the first sustained trap catch in Richmond or Pitt Meadows. Although the SWD degree day model has an upper temperature threshold of 30°C (86°F), this temperature was not reached between March 1 and June 30, 2014, in Richmond or Pitt Meadows and thus did not affect the degree day calculations that predicted first moth flight or first egg laying. The upper temperature threshold was exceeded in Pitt Meadows on July 1, 2014, which may have affected the predicted end date of the egg laying period in this region.

RESULTS AND DISCUSSION

Flight activity (Cranberries):

Male moths were caught in pheromone traps from the week of June 9 to the week of August 4, 2014. This was approximately one week earlier than the first catch in 2013 and three weeks

earlier than the first catch in 2012. Moths were caught in traps for a period of nine weeks this season compared to eight weeks in 2013 and seven weeks in 2012 (Fig. 1).

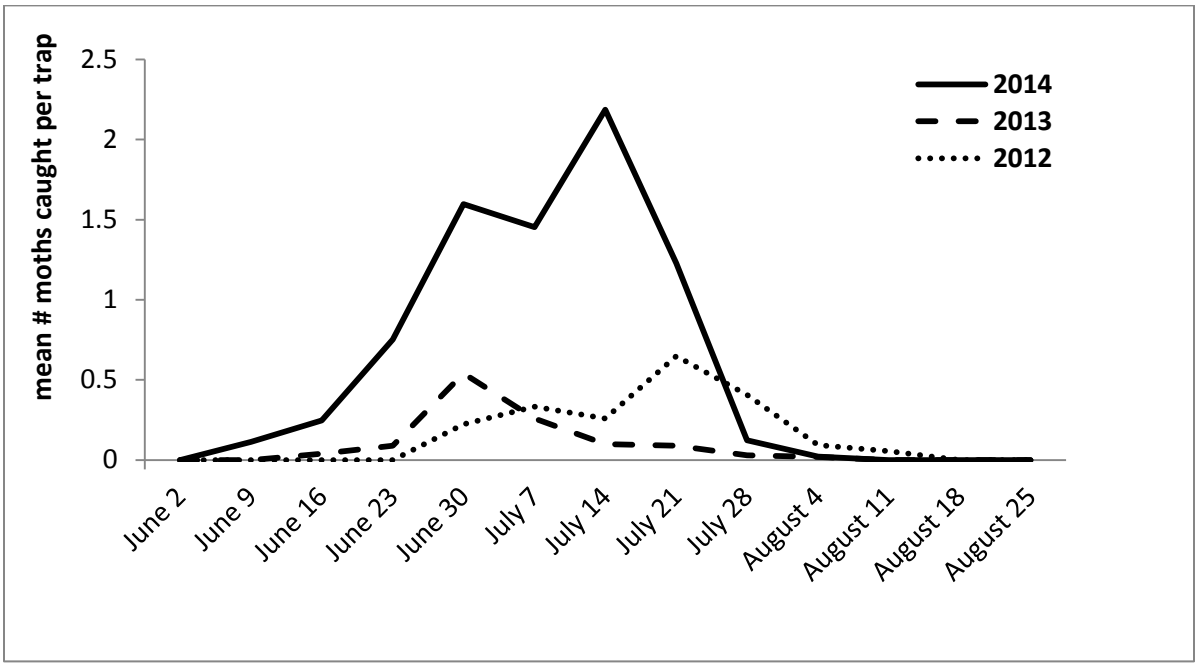

Figure 1. Pheromone trap catches of male cranberry fruitworm (*Acrobasis vaccinii*) moths in cranberries during the 2012, 2013 and 2014 field seasons

An extended period of peak moth flight was observed in 2014, as trap catches remained high from the week of June 30 to the week of July 14 (Fig. 1). The true peak moth flight (highest number of moths caught) occurred during the week of July 14, but the week of June 30 contained the highest percentage of farms with positive trap catches (Fig. 2). It should be noted that a pheromone lure change took place the week of July 6 and may have affected trap catches. When compared to previous seasons, the true peak in trap catches was approximately two weeks later than in 2013 (moth flight peaked on July 1st, 2013) and approximately one week earlier than in 2012 (moth flight during week of July 23, 2012). The total number of moths caught across all fields at peak moth flight was 212 moths, which is much higher than previous peak catches from 2013 (54 moths) and in 2012 (35 moths) (Fig. 1). However, the number of traps placed in fields has varied each year. On a per trap basis, the number of moths caught each year was 2.2 moths/ trap in 2014, 0.5 moths/ trap in 2013, and 0.7 moths/ trap in 2012 (Fig. 1), indicating an increase in the CBFW population in cranberry fields in 2014 compared to the two previous years.

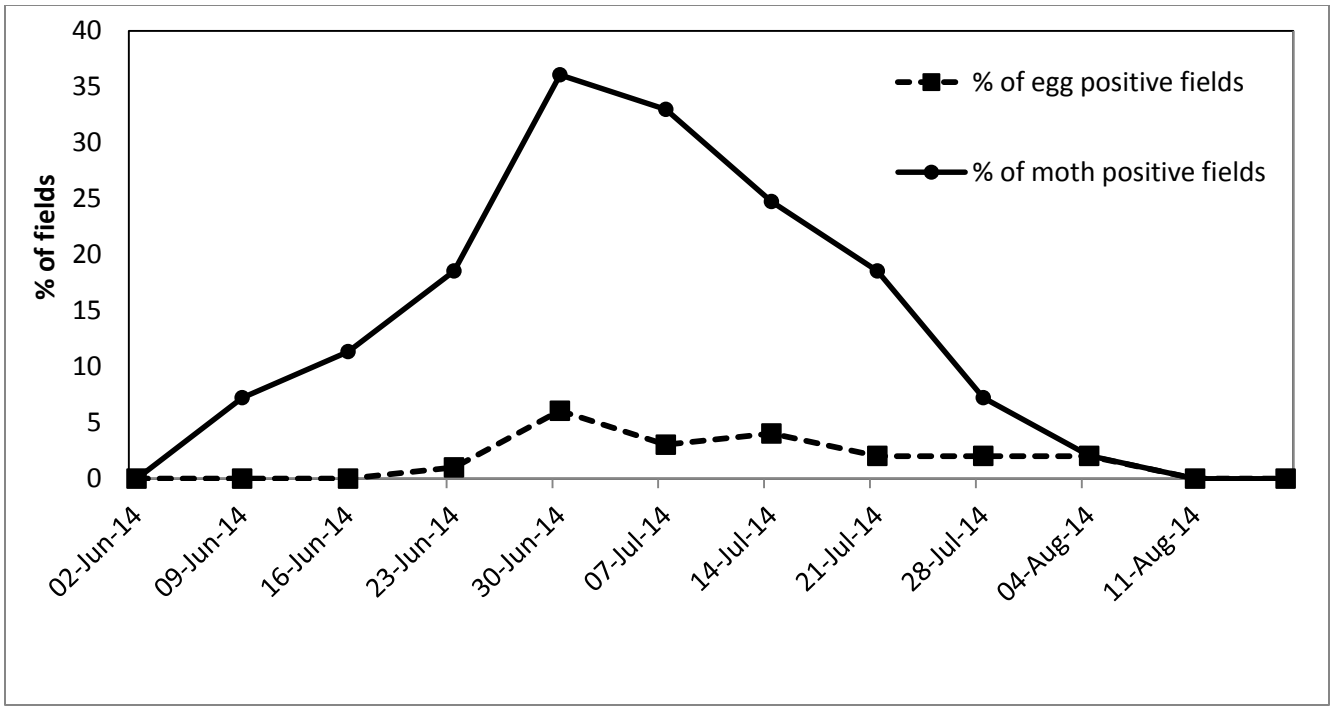

Figure 2. A comparison of the percentage of cranberry fields positive for eggs and positive for moths.

In 2014, the highest number of CBFW moths was caught in the West Delta and South Richmond regions. These regions, in addition to the East Delta region, saw the highest trap catches in 2012 and 2013. Trap catches decreased in the East Delta region in 2014 when compared to 2013. Data for the number of moths caught per farm in 2013 and 2014, the date of peak trap catch, and the insecticide sprays applied against CBFW is provided in Appendix 1 (Table 8). Trap catches in West Delta remained similar to last season with the exception of one farm (West Delta 3). The increase in moth catches in West Delta 3 may be partially due to the lack of a CBFW insecticide spray in the previous season (Appendix 1, Table 8). It should be noted that some farms which did make the recommended two applications of registered insecticides (i.e. Altacor or Intrepid) in 2013 also saw an increase in population size in 2014 (see South Richmond farms). This indicates that other factors may be contributing to the increase in CBFW populations, such as spray timing and microclimates in the fields, or regional winter and spring conditions. Spring 2014 was warm and dry; more conducive to survival and emergence of moths.

Cranberry fruitworm moths were caught in 20 fields that did not have trap catches in 2013. In contrast, three fields that caught moths in 2013 had no moths in 2014 (Appendix 1, Table 8). The greatest area of new moth detection was the North Richmond region where five farms had trap catches for the first time. Additionally, moths were captured in the Pitt Meadows/Maple Ridge region, which did not have any positive fields in the 2013 season (1 suspect moth caught in 2012- PMMR 1). In 2014, 52% (50 out of 97) of traps were positive for CBFW, compared to 33% in 2013 (33 out of 100) and 26% (14 out 54) in 2012.

Flight activity (Blueberries):

Moths were caught in blueberry fields for nine consecutive weeks from June 9 to August 8, 2014 (Fig. 2a). Peak trap catch occurred between July 7 and July 25, 2014. Total moth catches in blueberry fields were significantly lower than in cranberry fields. On July 14, peak moth catch in both crops, cranberry had an average catch 7 times higher than blueberry (2 moths per trap in cranberry fields compared to 0.3 moths per trap in blueberry fields).

Figure 2a. Number of Cranberry fruitworm moths caught per trap per week in 60 traps across 28 blueberry fields and 9 regions in the Fraser Valley in 2014

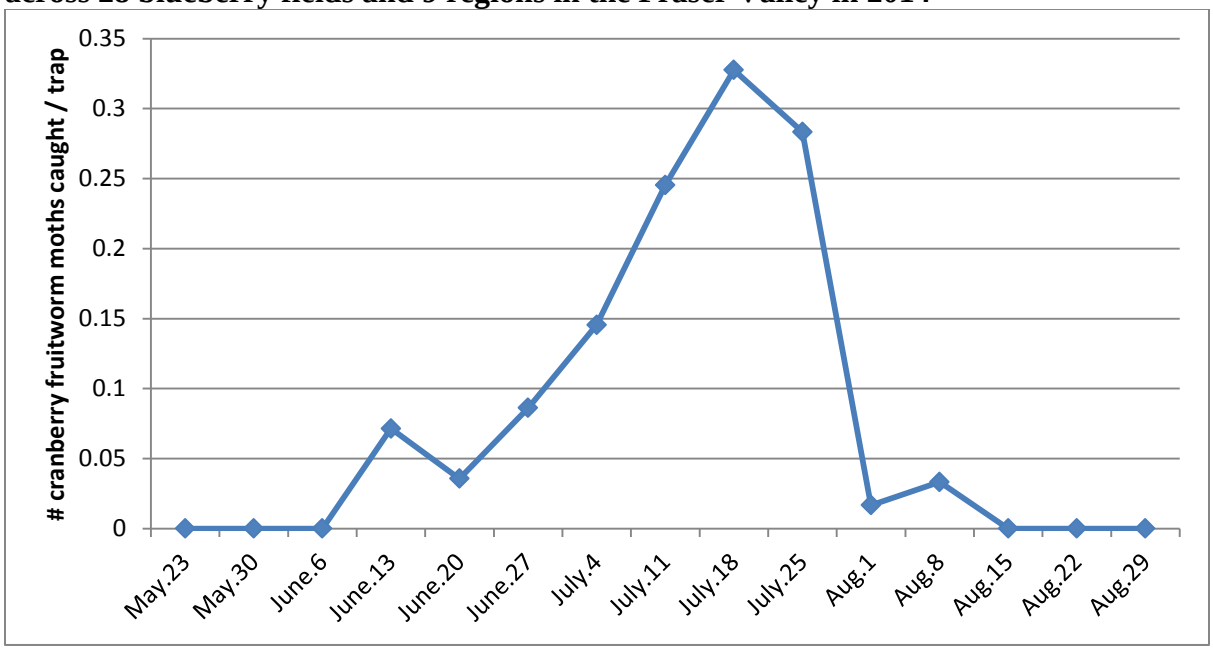

Table 3. Number of cranberry fruitworm moths caught in blueberry fields by region

Region	# traps	Total # moths caught and verified, June 13-July 11, 2014
Richmond	4	25
Ladner	6	3
East Delta	4	3
Surrey	6	0
Langley	6	0
Abbotsford	6	0
Matsqui	6	0
PoCo/Pitt Meadows	6	0
Pitt Meadows/Maple Ridge	6	1
Chillwack/Rosedale	6	0

Moths were caught in 5 out of the 28 blueberry fields. Trap catches occurred in Richmond, Ladner, East Delta, and 1 moth in Pitt Meadows/Maple Ridge (Table 3). CBFW distribution and abundance increased in blueberry fields in 2014 compared to 2013 when only one moth was caught in a Richmond field, adjacent to a cranberry field.

Fruit Damage Assessment in Cranberry

The first eggs were found on cranberry fruit on June 27 in the West Delta region. This was approximately 11 days after the first moths were detected in this field. Eggs were found on cranberry fruit collected from fields between June 27 and August 4, 2014. We did not detect eggs in all fields with moth catches. The greatest number of eggs was found during the week of June 30, and numbers gradually decreased in following weeks until Aug 11 when no more eggs were found (Fig. 3).

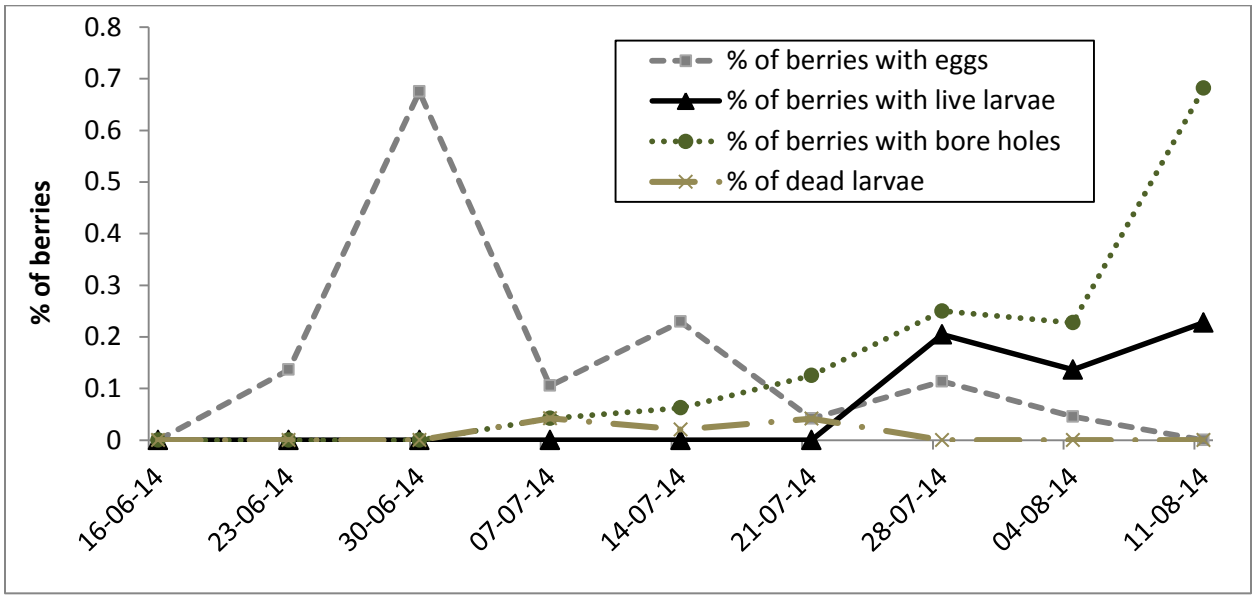

Figure 3. Cranberry fruitworm egg, larvae and berry damage assessments on cranberries collected from 19 positive cranberry fruitworm fields (from June 16 to August 11, 2014)

Interestingly, peak egg counts occurred the week of June 30th which was the first week of high trap catches. As traps were checked weekly, trap catches in any given week represent the number of moths that were caught from the previous week up to the current week (i.e. trap catches from the week of June 30 represents moths caught from week of June 23 to week of June 30). The synchronous peaks in trap catches and egg counts indicate that peak egg counts occurred within seven days of peak moth flight (Fig. 4).

Damage to berries (bore holes) was observed from July 7, 2014 until the last week of assessment, August 11 (Fig. 3.). The presence of feeding damage on berries one week after peak egg counts is consistent with the phenology of the CBFW from eastern North America and with results from our study in 2013. The highest percentage of damaged berries was observed the week of August 11, (Fig. 3), the last day of our sampling. Peak egg count was six weeks before this date. As

expected, the levels of damage corresponded to increases in larval numbers; including the dead larvae which may cause berry damage before mortality (Fig. 3).

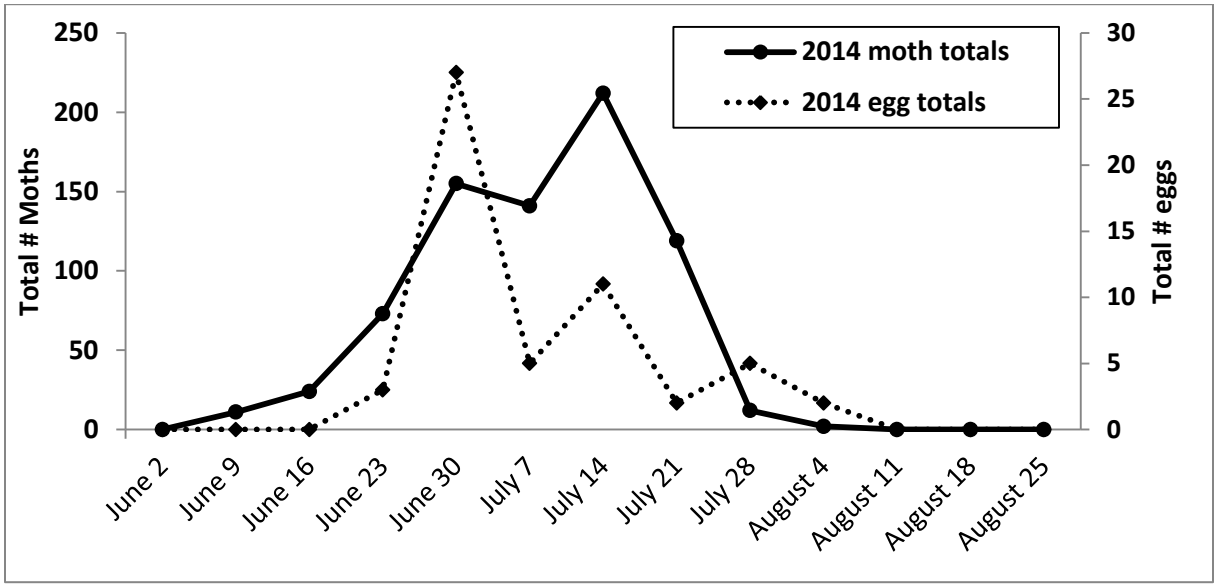

Figure 4. Cranberry fruitworm total weekly moth catches in all fields and total weekly egg counts from berry samples in cranberry fields.

Larvae were found in green berries collected from the fields from the week of July 7 to the week of August 11, which was the last week of field sampling (Fig. 3). Specifically, dead larvae were found from July 7 to July 21 and live larvae were found the weeks of July 28 to August 11. Insecticide sprays targeting CBFW were applied from the weeks of June 25 to July 28 (Fig. 5). The greatest percentage of fields were sprayed during the week of June 30 followed by July 14, 2014 (many of the fields were sprayed twice). During the weeks when most fields were sprayed, only dead larvae were observed. Live larvae were only found later in the season after most insecticide sprays had stopped. This indicates that sprays for CBFW were effective, but may not have controlled larvae that hatched later in the season (large spike in larvae from July 28 onwards). It is possible that 2 to 4 sprays may be required for this pest as moth emergence and egg laying occur over an extended period of time (Mahr, et.al, 2010). British Columbia cranberry growers would benefit from more research into the optimal number and timing of insecticide applications for control of CBFW in our growing regions.

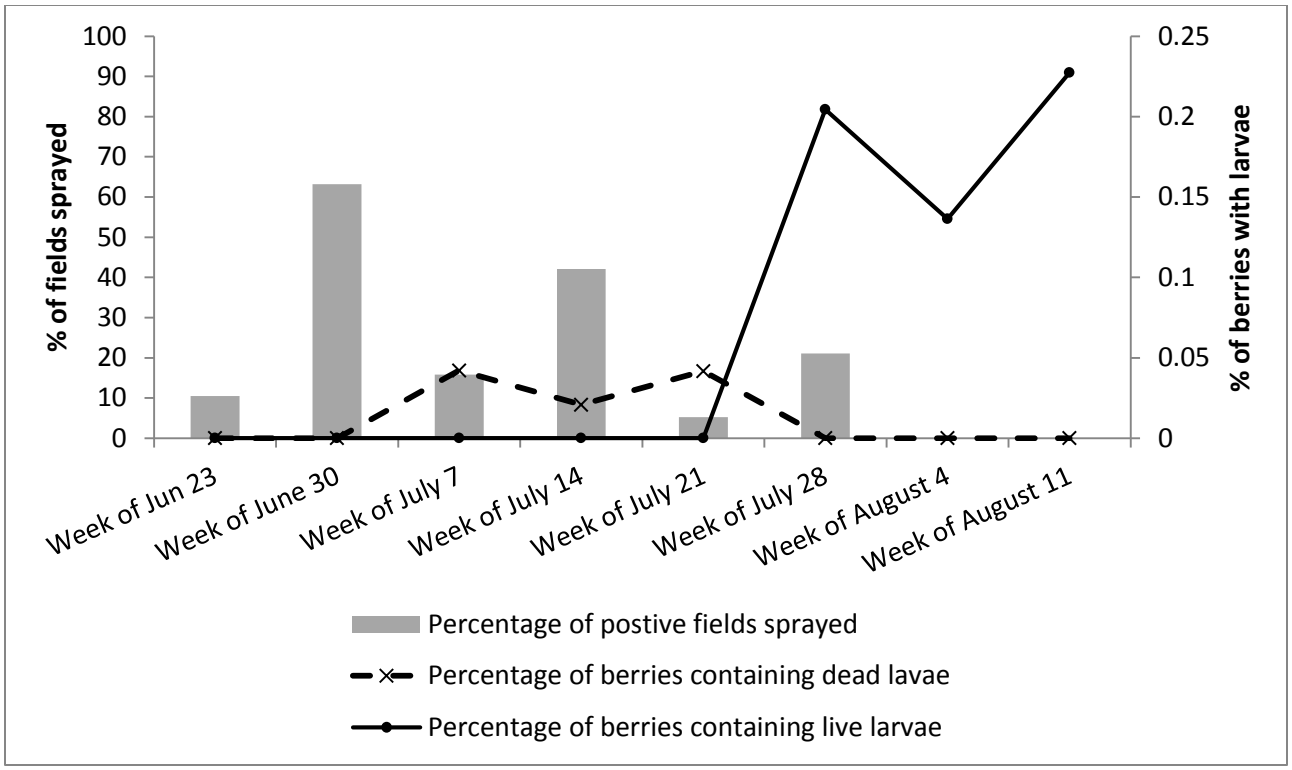

Figure 5. Percentage of cranberry fields sprayed for cranberry fruitworm and percentage of sampled berries with dead or live cranberry fruitworm larvae each week in the 19 cranberry fruitworm positive fields.

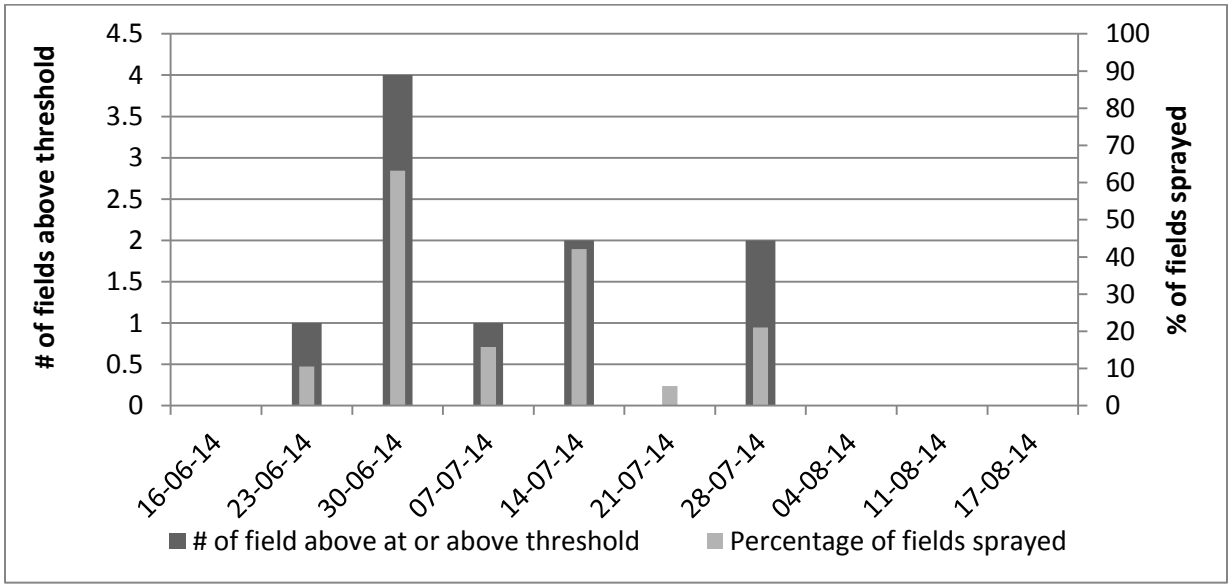

Figure 6. Number of cranberry fields at or above the threshold of 1 egg/100 fruit by assessment week and the percentage of fields sprayed for cranberry fruitworm by week.

Not all fields with moths in traps had damage detected on fruit. The action threshold recommended for Wisconsin is 1 egg/100 berries (Mahr 2011). This threshold was first reached the week of June 23 (Fig. 6). At green berry assessments, 6 of the 19 fields (30%) that were checked for eggs had egg levels high enough to warrant a spray (based on the Wisconsin threshold) (Table 4). However, berry damage assessments in September indicated that 10 out of 20 fields (50%) with moth catches had berry damage prior to harvest (Table 5).

Table 4. Total number of eggs and damaged fruit observed in cranberry fruitworm positive fields during green berry assessment from June 17 to August 18, 2014.

Field #	Field name	Trap catches	Total eggs	Total damaged fruit observed
1	W. Delta 1-4	2	0	0
2	W. Delta 1-5	2	0	1
3	W. Delta 2-3	3	0	0
4	W. Delta 3-4	22	3	5
5	E. Delta 1-4	1	0	0
6	E. Delta 2-2	2	0	0
7	N. Richmond 1-4	1	0	0
8	N. Richmond 2-1	1	0	0
9	N. Richmond 4-3	2	0	0
10	N. Richmond 5-2	1	0	0
11	N. Richmond 6-2	1	0	0
12	N. Richmond 8-1	1	1	0
13	S. Richmond 4-2	27	3	10
14	S. Richmond 2	51	20	39
15	S. Richmond 5-3	20	13	0
16	S. Richmond 3-1	56	9	1
17	S. Richmond 1-1	29	4	5
18	PMMR 1-3	1	0	0
19	PMMR 2-2	5	1	0

Amount of damage detected was quite variable, however, ranging from 0.21 to 10.73% fruit with damage in the sample (1 fruit out of 400 with damage, to 10 fruit out of 100 with damage). Pre-harvest ripe berry damage levels in 2013 were slightly lower; up to 6.85% overall. The working upper limit for fruit defects is 6% before downgrading or penalties are implemented due to insects or other types of defects. Considering this, only 3 fields (highlighted in Table 5) out of the 19 with moths were at risk of quality implications at the fruit receivers.

No berry damage was observed in fields with 1 moth caught per season, and no damage was observed in the 5 sampled fields where no CBFW moths were caught.

Table 5. Ripe berry damage assessments in September 2014 from cranberry fruitworm positive fields in 2014.

Field #	Field	Trap catches	% of berry damage (Week of September 5)	% of berry damage (Week of September 19)
1	**W. Delta 1-4**	2	0	0
2	**W. Delta 1-5**	2	0	0.27
3	**E. Delta 2-2**	2	0	0.2
4	**W. Delta 2-3**	3	0	1.38
5	**E. Delta 1-4**	1	0	0
6	**W. Delta 3-2**	38	1.34	0.35
7	**W. Delta 3-4**	22	3.33	5.71
8	**N. Richmond 6-2**	1	0	0
9	**N. Richmond 4-3**	2	0	0
10	**N. Richmond 2-1**	1	0	0
11	**N. Richmond 5-2**	1	0	0
12	**N. Richmond 1-4**	1	0	0
13	**S. Richmond 4-2**	27	3	3.5
14	**S. Richmond 2**	51	10.73	6.71
15	**S. Richmond 5-3**	20	0	0
16	**N. Richmond 8-1**	1	0	0
17	**S. Richmond 3-1**	56	7.8	1.65
18	**S. Richmond 1-1**	29	1.17	0
19	**PMMR 1-3**	1	0	0
20	**PMMR 2-2**	5	0.21	0

Fruit Damage Assessment in Blueberry

Out of all the fruit evaluated for fruitworm presence or damage, no evidence of any life stages or damage was ever seen in any samples. Blueberry appears to be unaffected by CBFW in BC at this time.

Degree Days

Using Richmond airport temperatures in the cranberry fruitworm degree day model, first moth flight was predicted to occur in Richmond fields on June 6, 2014 and egg-laying was predicted to begin June 10 (Table 6). The first trap catch in both cranberries and blueberries in Richmond occurred between June 2-9, which corresponds with the predicted date of first moth flight. This suggests that cranberry fruitworm degree day model from MSU is relevant to CBFW development in the Fraser Valley when used with Richmond airport temperatures. Using the degree day model to predict moth flight could help in future years to determine when to set up pheromone traps or implement biweekly pheromone trap checks in May-June to set the biofix date for egg laying predictions.

The degree day model predicted an earlier date for first egg laying in the fields than the earliest egg detected on collected fruit. Egg laying was predicted to begin June 10, 2014, but the first egg was found on June 27, 2014 (fruit collections began on June 17 in two wet-pick fields with moth catches). Fruit was not collected in three of the six fields with early trap catches because these fields were dry-pick fields and no green fruit was present until June 30. More intensive fruit collections occurred the weeks of June 23 (11 fields) and June 30 (20 fields). If possible, more fields with green fruit in early-mid June be collected from to verify relevance of the MSU model for Fraser Valley cranberries, however, if moths aren't flying or green fruit isn't present, then there is no pest risk at that time anyway.

Table 6. Predicted and observed dates of first moth flight and egg laying in Richmond and Delta cranberry and blueberry fields using Richmond airport temperatures in the CBFW degree day model from MSU.

Event	DD_{50}	Predicted date of occurrence	Cranberry - observed date of occurrence	Blueberry - observed date of occurrence
First moth flight (biofix)	350 DD_{50} after March 1	June 6, 2014	June 2-9, 2014	June 2-9, 2014
Egg laying begins	85-100 DD_{50} after first trap catch	June 10, 2014	June 27, 2014	No eggs found
Egg laying ends	400 DD_{50} after first trap catch	July 7, 2014	August 4, 2014 *last yellow (new) egg found	No damage found

First moth flight in Pitt Meadows berry fields was predicted to occur on May 30, 2014, but the first moth catch did not occur until June 17-24 in cranberries (Table 7). Trap catches were low in this region, with only 9 moths caught in cranberries, and all moths caught between the weeks of June 23 and July 7. Only one egg was found on July 17, 2014 on cranberries collected from Pitt Meadows. The poor fit of the degree day model to observed moth flight and egg counts is likely due to the low CBFW population in this region. To better evaluate the predicted date of first moth flight next year, additional pheromone traps should be set up on the farms and in the hedgerow vegetation adjacent to the fields where positive trap catches occurred this year.
Field temperatures likely differ from the airport temperatures used in this model. Temperatures recorded from weather stations located within cranberry or blueberry fields and entered into the degree day model would likely provide a more accurate prediction of moth flight and egg laying activities.

Table 7. Predicted and observed dates of first moth flight and egg laying in Pitt Meadows cranberry and blueberry fields using Pitt Meadows airport temperatures in the CBFW degree day model from MSU.

Event	DD_{50}	Predicted date of occurrence	Cranberry - observed date of occurrence	Blueberry - observed date of occurrence
First moth flight (biofix)	350 DD_{50} after March 1	May 30, 2014	June 17-24, 2014	July 3-10, 2014
Egg laying begins	85-100 DD_{50} after first trap catch	June 24, 2014	July 17, 2014	No eggs found
Egg laying ends	400 DD_{50} after first trap catch	July 13, 2014	July 17, 2014	No damage found

SUMMARY

Cranberries

- CBFW activity continues to be concentrated in West Delta and South Richmond region. There was a decrease in moth catches in the East Delta region. No CBFW moths were caught in Langley, Surrey or Chilliwack cranberry fields in this survey.
- Moths were observed in 53% of the monitored cranberry fields in 2014. This is an increase from 2013 (33%) and 2012 (26%).
- Moths were caught in 20 new fields that did not have trap catches in 2013. Newly positive CBFW fields included catches in the Pitt Meadows/Maple Ridge and North Richmond region.
- Peak moth flight occurred over a three week period from June 30 to July 14, 2014. The highest percentage of trap-positive fields occurred the week of June 30, 2014, while the highest number of moths was caught the week of July 14, 2014.
- Peak egg laying occurred the week of June 30, 2014, and then gradually decreased until August 4.
- Cranberry fruit damage prior to harvest ranged from 0-10.7% in 2014 which was an increase from 2013 (0- 6.9%). However, the same fields that were high risk in 2013 were also high risk in 2014.

Blueberries

- Moths were caught in blueberry fields within the survey in Richmond, Ladner, and East Delta. One moth was detected in Pitt Meadows blueberry field for the first time. This matches the distribution in cranberry fields in our survey.
- While more moths were caught in 2014 blueberry fields than in 2013, CBFW still does not appear to infest B.C. blueberry fruit.

SUGGESTED NEXT STEPS

- Continue area-wide survey for CBFW in blueberry and cranberry fields in south western B.C. growing regions, to monitor pest distribution and impact on these crops.
- Train E.S. Cropconsult personnel to identify CBFW moths caught in pheromone traps to enable immediate fruit collection following first moth flight
- Determine if existing thresholds - e.g. Wisconsin threshold of 1 egg/100 fruit or Massachusetts threshold (which assumes that fields with previous history of fruitworm will need sprays) - are appropriate for the Fraser Valley.
- Develop a trap catch threshold (minimum number of moths caught per trap) that corresponds with fruit damage later in the season by sampling more cranberry fields for fruit damage in September.
- Further evaluate the predictions of the MSU degree day model with another year of pheromone trapping. Do more intensive green fruit collections at the beginning and end of moth flight to determine the duration of the CBFW egg laying period in the Fraser Valley.

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Appendix 1- Table 8. Seasonal total trap catch, date of peak trap catch and timing of insecticide application(s) per field for each of the 53 cranberry fruitworm positive fields in 2013 and 2014

Field	Total trap catches (2013)	Week of peak trap catches (2013)	Insecticide spray date and product (2013)	Total trap catches (2014)	Week of peak trap catch in (2014)	Insecticide spray date and product (2014)
***East Delta 1-1**	1	July 1	Altacor: July 12	1	June 30	Altacor: July 9 Sevin: July 26
East Delta 1-4	3	July 1	Altacor: July 12	0	N/A	Altacor: July 9 Sevin: July 26
East Delta 2-1	11	July 1	Intrepid: July 12	2	July 7	Intrepid: June 25 Intrepid: July 11
***East Delta 2-2**	13	July 1/8*	Intrepid: July 12	2	June 23/ July 7	Intrepid: June 25 Intrepid: July 11
West Delta 2-2	1	June 24	Intrepid: July 13	1	August 4	Intrepid: June 25 Altacor: July 10
***West Delta 2-3**	1	July 15	Intrepid: July 13	3	June 23/June 30/July 14	Intrepid: June 25 Altacor: July 10
West Delta 2-4	2	July 1/8	Intrepid: July 3 Altacor: July 13	6	June 30	Intrepid: July 1 Altacor: July 15
West Delta 2-5	1	July 1	Intrepid: July 3 Intrepid: July 13	0	N/A	Intrepid: June 25 Altacor: July 10
West Delta 3-1	1	July 8	No spray	53	July 14	Diazinon: July 2 Intrepid: July 28
West Delta 3-2	6	July 8	No spray	38	July 21	Diazinon: July 2 Intrepid: July 28
West Delta 3-3	4	July 15	No spray	43	July 14	Diazinon: July 2 Intrepid: July 28
***West Delta 3-4**	1	July 1	No spray	22	July 14	Diazinon: July 2 Intrepid: July 28
West Delta 3-5	5	July 22	No spray	9	July 14	Entrust: July 18
West Delta 3-6	1	July 22	No spray	17	July 21	Entrust: July25
West Delta 3-7	0	N/A	No spray	11	July 14	Diazinon: July 2 Intrepid: July 28
West Delta 3-8	1	July 8	No spray	23	July 14	Diazinon: July 2 Intrepid: July 28
West Delta 1-1	1	July 22	Intrepid: July12 Intrepid: July 18	4	July 7	Intrepid: July 4 Sevin: July 15
West Delta 1-3	0	N/A	Intrepid: July12 Intrepid: July 18	4	June 30	Intrepid: July 4 Sevin: July 15
***West Delta 1-4**	4	July 8/15	Intrepid: July12 Intrepid: July 18	2	June 23/July 7	Intrepid: July 4 Sevin: July 15
***West Delta 1-5**	2	July 1	Intrepid: July12 Intrepid: July 18	2	June 23/ July 7	Intrepid: July 1 Sevin: July 15
West Delta 1-East	3	July 8	Intrepid: July12 Intrepid: July 18	0	N/A	Intrepid: July 1 Intrepid: July 17
West Delta 1-West	5	July 1	Intrepid: July12 Intrepid: July 18	1	June 30	Intrepid: July 1 Intrepid: July 17
***South Richmond 1-1**	3	June 24	Altacor: July 5 Altacor: July 19	29	June 23	Intrepid: July 2 Altacor: July 15
South Richmond 1-2	0	N/A	Altacor: July 5 Altacor: July 19	12	June 23	Intrepid: July 2 Altacor: July 15
South Richmond 1-	2	July 22/29	Altacor: July 5 Altacor: July 19	17	July 7	Intrepid: July 2 Altacor: July 15

3						
South Richmond 1-4	5	July 1	Altacor: July 5 Altacor: July 19	14	June 23	Intrepid: July 2 Altacor: July 15
***South Richmond 2**	1	July 29	No Sprays	51	July 21	Altacor: July 2 Altacor: July 29
South Richmond 4-1	0	N/A	Altacor: July 7 Altacor: July 16	55	July 14	Altacor: July 2 Altacor: July 15
***South Richmond 4-2**	8	July 1	Altacor: July 7 Altacor: July 16	27	June 30	Altacor: July 2 Altacor: July 15
South Richmond 4-3	7	July 1	Altacor: July 7 Altacor: July 16	67	June 30/July 14	Altacor: July 2 Altacor: July 15
South Richmond 4-4	1	July 1	Altacor: July 7 Altacor: July 16	21	June 30	Altacor: July 2 Altacor: July 15
***South Richmond 3-1**	11	July 1	Altacor: July 7 Altacor: July 16	56	June 30	Altacor: July 2 Altacor: July 15
South Richmond 3-2	2	July 1	Altacor: July 7 Altacor: July 16	14	June 30/ July 14	Altacor: July 2 Altacor: July 15
South Richmond 3-3	1	July 1	Altacor: July 7 Altacor: July 16	34	July 14	Altacor: July 2 Altacor: July 15
South Richmond 3-4	1	July 8	Altacor: July 7 Altacor: July 16	42	July 7	Altacor: July 2 Altacor: July 15
South Richmond 5-2	7	July 1	Altacor: July 7 Altacor: July 20	21	June 30/July 14	Altacor: July 1 Altacor: July 15
***South Richmond 5-3**	0	N/A	Altacor: July 7 Altacor: July 20	20	June 23	Altacor: July 1 Altacor: July 15
***North Richmond 1-4**	1	June 24	No spray	1	June 30	Altacor: July 29
***North Richmond 8-1**	N/A	N/A	N/A	1	June 30	Altacor: July 17
***North Richmond 5-2**	0	N/A	N/A	1	July 7	Diazinon: July 4 Sevin: July 20
North Richmond 5-10	0	N/A	N/A	3	July 14	Diazinon: July 4 Sevin: July 20
North Richmond 5-11	0	N/A	N/A	1	July 14	Diazinon: July 4 Sevin: July 20
***North Richmond 6-2**	0	N/A	N/A	1	June 30	Altacor: July 3
***North Richmond 2-1**	0	N/A	N/A	1	July 14	Diazinon: July 30
***North Richmond**	0	N/A	N/A	2	July 7/ July 21	None

4-3						
North Richmond 4-4	0	N/A	N/A	1	June 30	Altacor: July 5 Diazinon: July 11
North Richmond 4-5	0	N/A	N/A	2	July 7/ July 21	Diazinon: July 5 Sevin: July 18
North Richmond 4-6	0	N/A	N/A	2	July 7/July 28	Diazinon: July 5 Diazinon: July 11
PMMR 2-1	0	N/A	N/A	1	June 30	Altacor: June 30
***PMMR 2-2**	0	N/A	N/A	5	June 30/July 7	Altacor: June 30
***PMMR 1-3**	0	N/A	N/A	1	June 22	Altacor: July 1
PMMR 1-5	0	N/A	N/A	1	July 7	Altacor: July 1
PMMR 1-6	0	N/A	N/A	1	July 7	Altacor: July 10

***** Indicates fields were berry samples were taken from during the growing season.