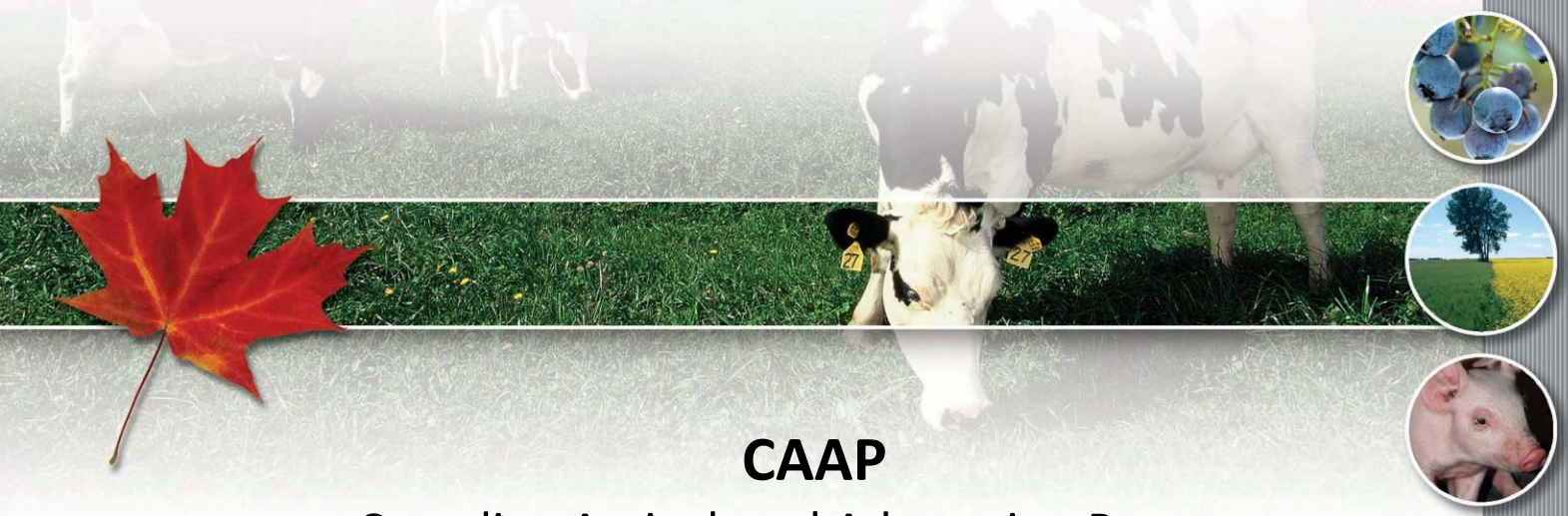

CAAP

Canadian Agricultural Adaptation Program

Final Report

Adaptation of a cranberry tipworm (*Dasineura oxycoccana*) adult monitoring method in cranberry production

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The final report forwarded to the CDAQ in hard copy and in Word copy must include:

- ❑ *the deliverables described in Appendix C of the financial contribution agreement;*
- ❑ *the supporting documents,numberedand written in the* Financing Plan and Expenditure Reconciliation *document;*
- ❑ *the copies of the dissemination documents mentioning the CAAP's contribution according to the program's exposure rules.*

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1. *OBJECTIVES*

1.1. General Objective

Cranberry production in Quebec represented $66 million of income in 2008. Since 1999, the area of production increased by 10% each year and in 2001, the area of production covered 2,379 hectares. There are 38 insect pest species attacking different parts of the cranberry plant. Since 2000, the CETAQ has offered pest monitoring services and has visited nearly all fields cultivated every week during the season. The cranberry tipworm, *Dasineura oxycoccana* Johnson, is among the major insect pests attacking the cranberry in conventional and organic farms in Quebec. Shoots damaged by this pest produce 50% less fruits the following year than undamaged shoots (Le Duc et al. 2010). This pest has three generations per year and the only monitoring method available is the sampling and observation of 100 shoots under a binocular to count eggs, larvae and pupae. This unpredictable method gives a portrait of the population in the field and the producer has limited time to react and apply a pesticide treatment. Roubos and Liburd (2010) have developed emergence traps for *D. oxycoccana* in blueberry production in the United-States. Having a new monitoring method with emergence traps could allow making predictions on the peak of eggs and would allow for optimization of pesticide applications. The objective of this study is to test new emergence traps to offer new monitoring tool to agronomists for managing the cranberry tipworm.

1.2. Specific Objectives

1-To evaluate the efficacy of two cranberry tipworm adultmonitoring methods in cranberry fields;

2-To determine the number of traps required for optimal monitoring and their location in the fields;

3-To relate the cranberry tipworm adult population to degree days;

4-To compare the costs of two monitoring methods: shoot dissection and use of emergence traps.

2. RESULTS AND ANALYSIS

2.1. Identification of the best emergence trap for early cranberry tipworm adult monitoring

Material and methods

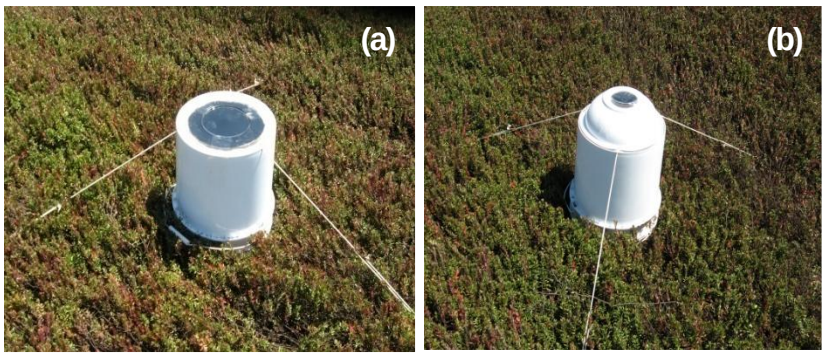
In 2012, emergence traps were deployed in three cranberry fields from three different farms for a total of nine plots. Two farms were conventional (A and B) and the third was certified organic (C).

Two types of trap were tested in these plots: the Petri dish (P1)and plate (P2) traps (Picture 1). Both types of trap were assembled using black 18.9 L (5 gallons US) buckets. The outside of these buckets was covered with white paint and the bottom was cut out so that a circular

opening (ø = 24 cm) would be created. Putty was spread around the opening of P2 traps (Picture 1a) and plates (ø = 26 cm), with their inner sides smeared with Tanglefoot®, were pressed in the putty (Picture 1a). Further fixation of the plate was achieved with clear tape. For P1 traps (Picture 1b), plastic salad bowls were glued to the bottom of the buckets. The bottom of these salad bowls was cut out so that a circular opening (ø = 9.5 cm) would be created and these openings were covered with Petri dishes (ø = 10 cm) with their inner sides smeared with Tanglefoot®. Clear tape was used to keep the dishes in place. Three ropes were fixed to the rim at the bottom of each bucket, for both P1 and P2 traps. Metal tent pegs were attached to the other end of the ropes and,when deploying the traps in the fields, the pegs were pushed in the soil to keep the traps in place.

In 2013, eight conventional farms and one organic farm were added to the three chosen in 2012. P2 traps were abandoned in 2013 and so, onlyP1 traps were deployed in the 12 plots, one field per farm.

All plots from both years were divided into 12 sections where traps would be deployed (Figure 1). In 2012, a total of 12 × 9 × 2 = 216 traps (108 for each type of trap) were deployed and in 2013, the total was 12 × 12 = 244 traps. Traps were placed on the perimeter of a circle (r = 10 m) with its centre at the centre of the section itself. In 2012, the two types of trap were paired; the P2 traps were always the closest to the centre of the circle and the P1 traps were 2 m further, so at a distance of 12 m from the centre of the circle. Using pegs fixed in the ground at the centre of the sections and a 10 m rope attached to the pegs, traps were moved 2 m counterclockwise every week so that newly emerging adults could be caught. However, from May 13 to June 20 2013, traps were moved 2 m counterclockwise twice a week to obtain more precise data on first generation adults. The traps were arranged in complete randomized blocks with repeated measures.



Picture 1. Plate (a) and Petri dish (b) traps set in a cranberry field.

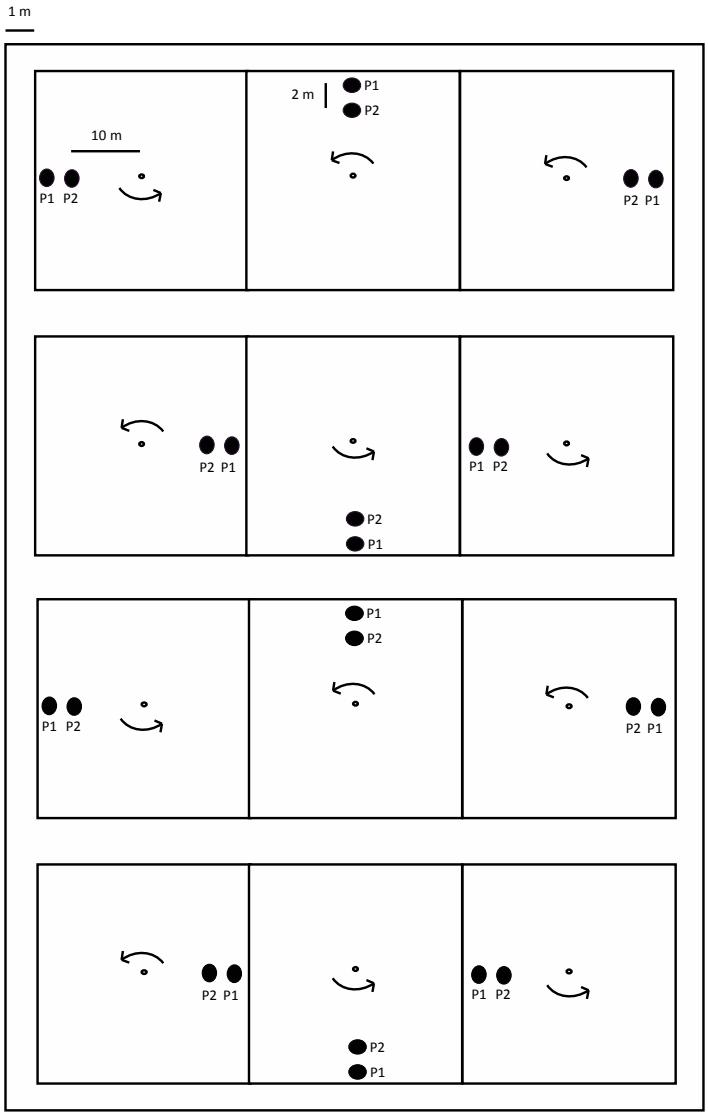
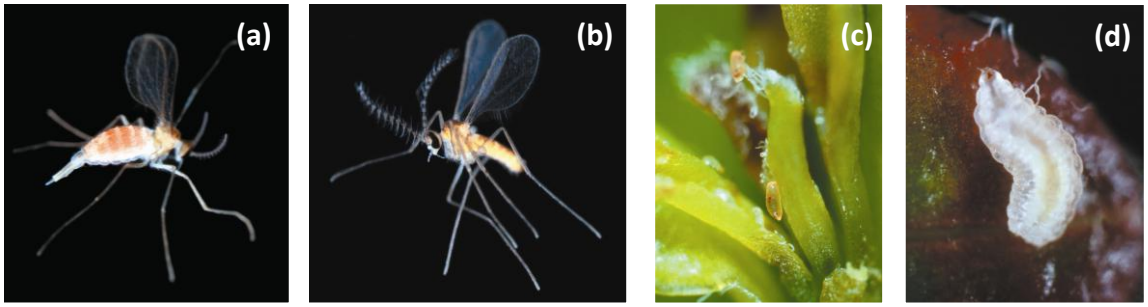


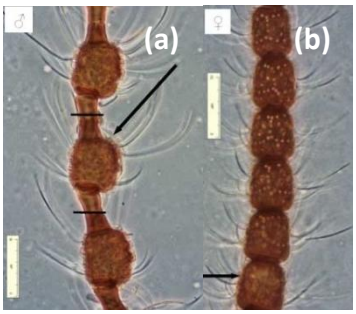
Figure 1. 2012 disposition of Petri dish (P1) and plate (P2) traps in a cranberry field. Arrow indicates the direction of trap rotation around the central peg in each section. In 2013, only the P1 traps were deployed in the plots.

In 2012 and 2013, the Petri dishes and trays were replaced every week by new ones, also with their inner sides covered with Tanglefoot®.The Petri dishes and trays were then brought to the laboratory andstored in the fridge until the observation of the specimens. Two plateswere sent to Dr. Bradley Sinclair, taxonomist for the National Collection of Ottawa, who confirmed our identifications. All specimens pertaining to the species *D. oxycoccana* were identified, sexed and counted.The females (Picture 2a), with their swollen rosy abdomen ending by an ovipositor

and their antennal segments lacking a peduncle(Picture 3a) can be differentiated fromthe males (Picture2b) whose abdomen is narrower, lacks an ovipositor and whose antennal segments have peduncles (Picture 3b).



Picture 2. Pictures of (a) a female, (b) a male, (c) an egg and (d) a larva of *D. oxycoccana* (Credit: Carole Germain, CFL).



Picture 3. Antennal section of (a) a male and (b) a female of *D. oxycoccana* showing differences in antennal structures (Website: E-Phytia, credit: E. Pierre).

During 15 weeks, eggs, larvae and pupae of *D. oxycoccana* were observed on 100 shoots sampled in nine plots in 2012 and 12 plots in 2013. Each shoot was observed under a binocularto count the eggs, larvae (Pictures 2c and d) and pupae in order to evaluate the number of damaged shoots. In 2013, one sample of 500 shoots was made in eachfarm at the end of October to evaluate the percentage of damage resulting from the tipworm feeding. These data are presented in section 2.1.2.

Statistical analysis

In 2012, the data were analyzed with a mixed linear generalized model (GLIMMIX, SAS). Data were paired for each plot because P1 and P2 traps were always together. In 2012 and 2013, we studied the effect of the trap and the week of sampling on the adult count by doing the sum of the 12 traps in each farms. We used a Spearman correlation to check the relation between adults observed at week T0 and eggs and larvae observed at week T1 for traps P1 and P2 (PROC CORR, SAS).

Results

In 2012

In general, the P1 trap captured significantly higher numbers of*D. oxycoccana* adults than the P2 trap in farms A and B (farm A: $F_{1,606}$=46.43; p<0.0001; farm B: $F_{1,69.5}$=7.89; p=0.0064) (Table 1). For each plot from each farm, Table 1 shows that mean numbers of *D. oxycoccana* were always higher in P1 trap than in P2 trap. Also, the number of adults captured was significantly different between weeks of sampling in farms A ($F_{8,130.5}$=90.42; p<0.0001) and B ($F_{6,206.3}$=60.34; p<0.0001).

In farm A, we observed a significant interaction between traps and week of sampling ($F_{8,606}$=27.17; p<0.0001) which means that the number of adults differed for a same trap in function of the week. During the weeks of June 19th, July 10th and July 17th 2012, no statistical differences were observed between adults captured in P1 and P2 traps($F_{1,606}$=0.8; p=0.3706; $F_{1,606}$=0.96; p=0.3275 and $F_{1,606}$=2.87; p=0.0909,respectively).

Fewer adults were captured in farm C and statistical analysis demonstrated that there was no significant difference between the two traps ($F_{1,161}$=2.97; p=0.0869) as well as the weeks of sampling ($F_{14,1}$=; p=0.1913) at this site (Table 1).

The estimates of count ratio indicated that P1 traps captured 25% to 50% more than P2 traps in farms A and B, respectively. This might be explained by the poor resistance of the putty to sun and rain which reduced the sealing ability of the material used to fix the plates of P2 traps. The utilization of the P2 trap over 15 weeks also demonstrated that the observation of plates with Tanglefoot® under a binocular was difficult.

Table 1. Mean numbers of *D. oxycoccana* captured in Petri dish and plate traps in three Quebec farms.

	Petridishtrap	Plate trap
Farm A	**9.3 ± 0.6 a***	**7.4 ± 0.5 b**
Plot 1	14.1 ± 22.1	9.8 ± 15.1
Plot 2	47.7 ± 14.3	4.8 ± 8.4
Plot 3	12.5 ± 19.5	8.7 ± 14.2
Farm B	**49.5 ± 5.2 a***	**32.5 ± 3.4 b**
Plot 1	62.8 ± 125.9	42.5 ± 83.0
Plot 2	22.2 ± 45.1	13.9 ± 23.3
Plot 3	44.4 ± 74.9	23.2 ± 36.3
Farm C	**0.6 ± 0.06 a***	**0.5 ± 0.04 a**
Plot 1	0.8 ± 1.4	0.6 ± 0.9
Plot 2	1.0 ± 1.5	0.8 ± 1.1
Plot3	0.9 ± 1.3	0.6 ± 0.9

* Different letters on the same line indicate that the mean numbers of adults capturedare significantly different between traps at α=0.05 with a GLIMMIX analysis (SAS).

In 2012, adults captured each week in P1 and P2 traps were significantly correlated with the mean numbers of eggs and larvae observed one week later in the plot (Table 2). Results showed that correlation coefficientswere higher for larvae than for eggs ($r > 0.82$ for farms A and B) (Table 2). **The number of adults observed at week T0 can predict up to 88% of the variation of the number of larvae observed at week T1 in 2012**.

A better correlation between adults and eggs rather than between adults and larvae can be explained by the low longevity of adults: 3.4 ± 0.2 days for males and 3.2 ± 0.2 days for females (Fitzpatrick 2009). Also, the development from egg to adult is achieved in 10–15 days (Gagné 1989). Then, within seven days, adults can lay eggs that can develop into larvae.

Table 2. Correlation analysis between adults captured at week T0 and eggs and larvae observed at week T1 in 2012.

	Petri dish trap		Plate trap	
	Eggs	Larvae	Eggs	Larvae
Farm A	r=0.712 p<0.0001	r=0.826 p<0.0001	r=0.718 p<.0001	r=0.853 p<0.0001
Farm B	r=0.742 p<0.0001	r=0.866 p<0.0001	r=0.742 p<0.0001	r=0.882 p<0.0001
Farm C	r=0.413 p=0.0065	r=0.544 p=0.0002	r=0.437 p=0.0038	r=0.472 p=0.0016

In 2013

Results in 2013 were identical to that of 2012: adults captured each week in P1 traps were significantly correlated with larvae observed one week later in the plot (Table 3). However, lower population of *D. oxycoccana* could have influenced the strength of the relation between adults and larvae; r coefficients were generally lower in 2013 than in 2012. **The number of adults observed at week T0 can predict up to 83% of the variation of the number of larvae observed at week T1 in 2013**.

Table 3. Correlation coefficients of the relation between adults captured at week T0 and eggs and larvae observed at week T1 in 2013.

	Eggs	Larvae
Farm A	r=0.328	r=0.499
Farm B	r=0.430	r=0.279
Farm C	r=0.551	r=0.830
Farm D	r=0.335	r=0.699
Farm E	r=0.493	r=0.590
Farm F	r=0.538	r=0.633
Farm G	r=0.411	r=0.552
Farm H	r=0.233	r=0.687
Farm I	r=0.016	r=0.779
Farm J	r=0.344	r=0.676

Farm K	r=0.253	r=0.496
Farm L	r=0.506	r=0.489

Conclusion

- ✓ *The Petri dish trap (P1) captured 25% to 50% more D. oxycoccana adults than the plate trap (P2).*
- ✓ *The P1 trap was selected following results observed in 2012 and because it was easier to manipulate under a binocular than the P2 trap.*
- ✓ *The numbers of D. oxycoccana captured in P1 traps werecorrelated with the numbers of larvae observed one week later in 2012 and 2013 and can predict up to 88 % of the larval population variation.*

2.2.To determine the number of traps required for optimal monitoring and their location in the fields

Statistical analysis

We calculated means for all the correlation coefficients between adults and larvae for each P1 trap position in all plots in 2012 and 2013. In order to select the best position in the field, the means for each position were divided into three classes ranging from the lower to the higher mean: low (yellow) – middle (green) – high (blue). The best three positions were then selected for each of the green and blue classes. Then, a correlation analysis was performed with data from one trap and the sum of data from two traps located in different positions to compare the strength of the relation between adults and larvae in function of the number and position of traps in the field. Finally, a correlation analysis was performed to determine the relation between the cumulated number of adults observed in 2013 in all traps and the percentage of damage observed on shoots in October in the 12 fields.

Results

Figures 2 and 3 indicate that the best mean correlation coefficientswere observed for traps in sections4, 5, 6, 9 and 11 in 2012 and traps 5, 7 and 12 in 2013. After having compared the means from both figures, we came to the conclusion that sections 5, 7 and 12 were the best to place traps for adult monitoring.

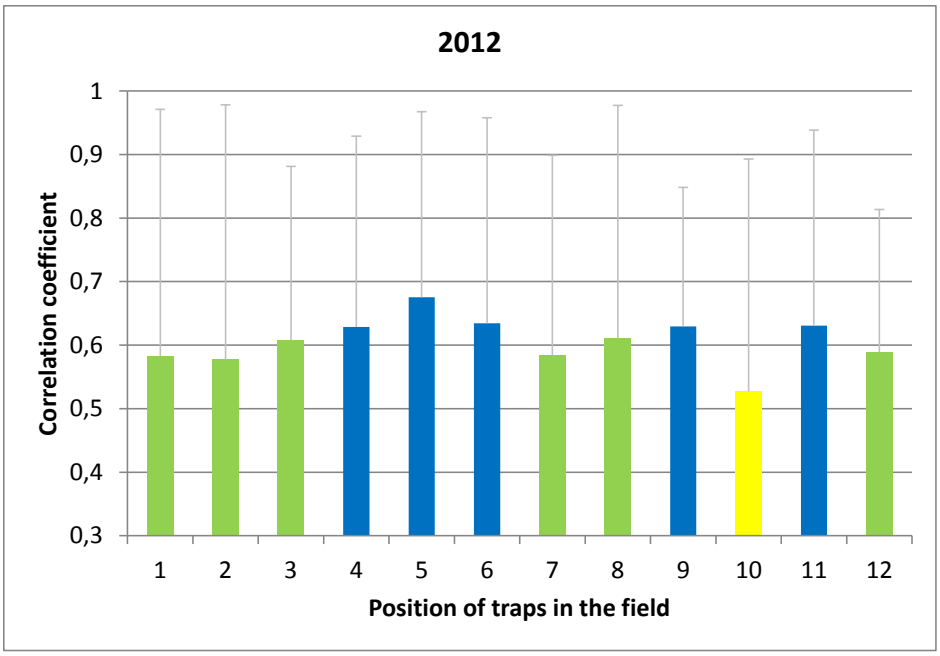


Figure 2. Correlation coefficients between adults observed at week T0 and larvae observed at week T1 for P1 traps from three farms in 2012 (Yellow: 0.52 < r ≤ 0.57; green: 0.57 < r ≤ 0.62 and blue: 0.62 < r ≤ 0.67).

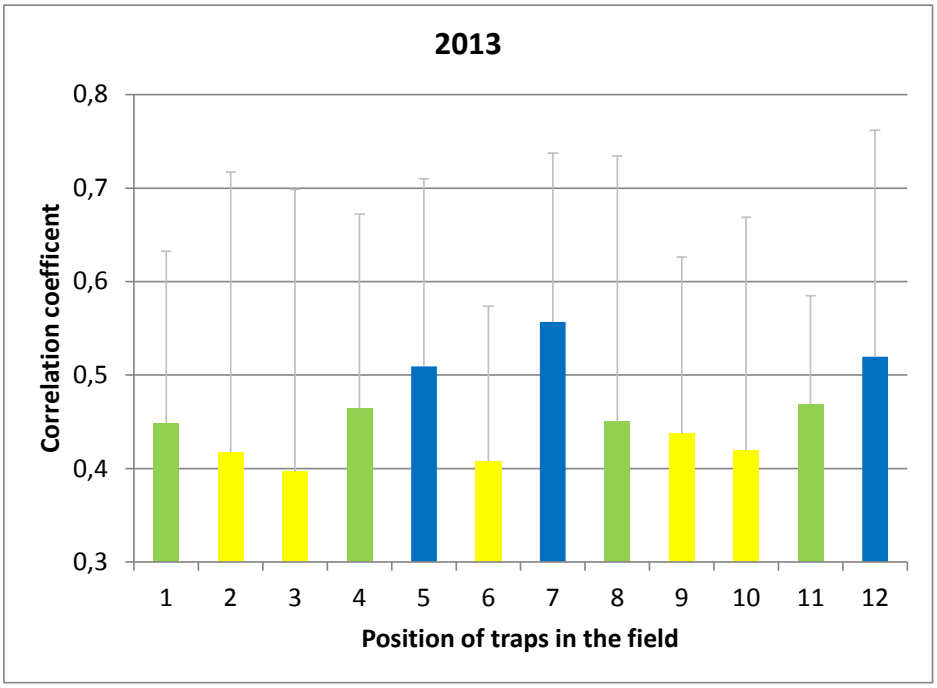


Figure 3. Correlation coefficients between adults observed at week T0 and larvae observed at week T1 for P1 traps from 12 farms in 2013 (Yellow: 0.39 < r ≤ 0.44; green: 0.44 < r ≤ 0.49 and blue: 0.49 < r ≤0.55).

From a producer or an agronomist perspective, to have a single trap by field should be the most suitable situation to monitor *D. oxycoccana* adults. However, we determined that having two traps in two different positions (positions 5 + 7 or positions 5 + 12) can improve the strength of the relation between adults and larvae. Table 4 indicates that the correlation coefficient

reaches 0.62 or 0.60 when two P1 traps are placed in the field at positions 5 + 7 or 5 + 12, respectively, compared to 0.53 when a single P1 trap is placed in position 5 (Figure 4).

Table 4. Correlation coefficients for the relation between adults observed at week T0 and larvae observed at week T1 when one or two traps were placed in the field.

Position	Correlation coefficient
5	0.5363
5 + 7	0.6296
5 + 12	0.6002

Figure 4.A typical cranberry bed with adult *D. oxycoccana* monitoring trap location. (Illustration: F. Vanoosthuyse)

The correlation analysis between the total number of adults captured in 2013 and the damage observed on shoots in October 2013 was not significant (p=0.1205).

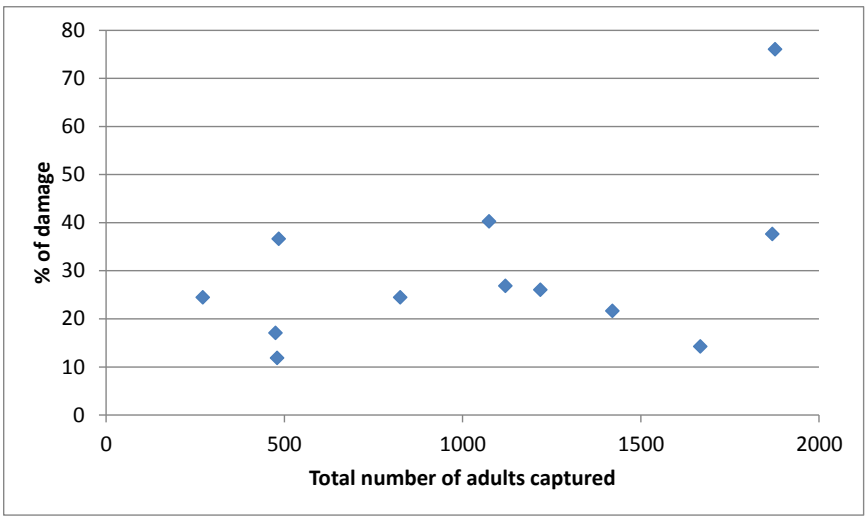


Figure 5. Percentage of damage observed on 500 shoots collected in October 2013 as a function of the total numbers of adults captured in Petri dish traps in 2013.

Conclusion

- ✓ *Monitoring adults of D. oxycoccana can be achieved byplacing a P1 trap in position 5 in the field when a single trap is used.*
- ✓ *Monitoring adults of D. oxycoccana can be achieved by placing P1 traps in positions 5 + 7 in the field when two traps are used.*
- ✓ *The total numbers of adults observed during the season cannot explain the damage observed on shoots at the end of the season.*

2.3. To relate the cranberry tipworm adult population to degree days

Material and methods

Data collected by the CETAQ and the IRDA were used to develop a degree days model for the cranberry tipworm that will be available in the software CIPRA. This software can predict the development of pest insects and diseases as well as plant phenology by using forecasting data. Producers and crop consultants use CIPRA to better target spray timing.

To complete the model, we usedadult numbers captured in2012 and 2013. We also used data from 2000 to 2013 for the egg and larva numbers observed on 100 shoots. Adults, eggs and larvae population profiles were generated to distinguish between the three generations. Using these data and the software DJPheno, developed by the bioclimatology and modelling team at Agriculture and Agrifood Canada, the number of degree days needed to reach a developmental level in function of the base temperature was calculated. For the cranberry tipworm, Axelsen (1992) estimated a base temperature of 6.7 °C for eggs and larvae developing in shoots and another of 8.1°C for adults emerging from pupae in the soil. In our analysis, we decided to use 7°C as a base temperature for all stages. For the model, levels of 5 %, 50 % and 95 % of eggs, larvae and adults were selected for the three generations. Degree days obtained for each level were compared to data observed from 2000 to 2013 with the help of a module in DJpheno. The

model generated was included in CIPRA and can, with forecasting data, calculate the daily degree day accumulation needed to reach different stages of the insect.

Results

Table 5 indicates the number of degree days needed to reach 5%, 50% and 95% of adults, eggs and larvae for the three generations of *D. oxycoccana.* Results show that the levels of adults and eggs are only separated by a few degree days for all three generations. Figure 6 shows the accumulation of degree days (dark blue line) over time. The dates at which the dark blue line crosses each of the horizontal coloured lines are the dates when the percentages of each level of *D. oxycoccana* stages should be observed in the field. Levels such as that of 1st and 3rd generation eggs and larvae were not included in Figure 6 as they were judged less relevant.

Table 5. Number of degree days needed to reach levels for three stages (adult, egg and larva) for three generations of *D. oxycoccana.*

Stage	Level %	Generation 1	Generation 2	Generation 3
Adult	5%	253 DD	473 DD	835 DD
	50%	333 DD	610 DD	954 DD
	95%	401 DD	750 DD	1254 DD
Egg	5%	265 DD	479 DD	831 DD
	50%	319 DD	580 DD	920 DD
	95%	388 DD	682 DD	1012 DD
Larva	5%	301 DD	514 DD	845 DD
	50%	373 DD	626 DD	942 DD
	95%	473 DD	735 DD	1054 DD

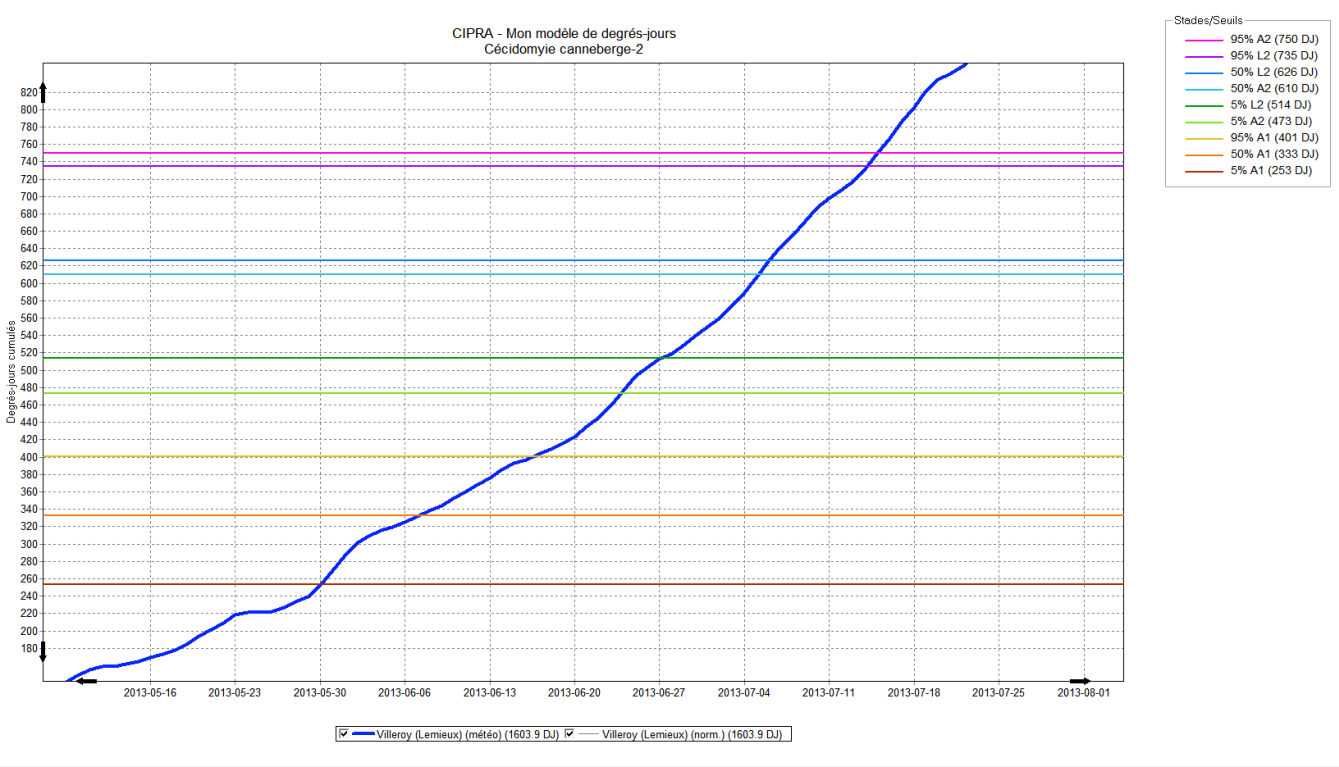


Figure 6. CIPRA output indicating the different levels of adults and larvae for the first two generations of *D. oxycoccana* as a function of degree days.

Conclusion:

- ✓ *By using data from 2000 to 2013, the model predicting observations of 5%, 50% and 95% level of adults and larvae of the first two generations of D. oxycoccana as a function of degree days is now available in the software CIPRA.*

2.4. To compare the costs of two monitoring methods: shoot dissection and use of emergence traps

Material and methods

To determine the cost of monitoring adults with a trap in comparison to sampling and observing 100 shoots, we have separated the cost of sampling and observing from the cost of assembling the traps.

In 2013, the time needed to monitor eggs, larvae and pupae on shoots was compared to the time needed to monitor adults with the emergence trap P1. These two methods are described under section 2.1.1. above. When sampling shoots, the recording of time started once the scout stepped on the field and stopped once 100 shoots were sampled.To this time was added the time needed to observe the 100 shoots under a binocular to count eggs, larvae and pupae. The duration of monitoring was recorded in 12 fields on July 9 (n=12).

With the emergence trap, we measured the time in six fields. Recording started once the scout stepped on the field and continued until the traps had been moved, the Petri dish changed and

the adults identified using a magnifying glass x10. The time needed to observe the same Petri dish in the laboratory with a binocular microscope was also recorded. The time spent walking from one trap to the others was not recorded because the field size from each farm varies.

Statistical analysis

With a one-way ANOVA (JMPin, SAS), the time needed to sample and to observe 100 shoots for counting eggs, larvae and pupae was compared to the time needed to move 12 traps and to count adults with a magnifying glass or a binocular. Using a Wilcoxon test (JMPin, SAS), we also compared the number of adults recorded from a Petri dish after observation with a magnifying glass to that from the same Petri dish after observation under a binocular.

Results

Figure 7 shows that sampling and observation of 100 shoots for one field lasts 34 minutes. Moving the 12 traps and observing adults under a binocular or with a magnifying glass is significantly faster with 23 and 22 minutes, respectively (Tukey-Kramer, $p<0.0001$). The recommendation from 2.1.2.is that one or two traps should be used in a field to monitor *D. oxycoccana* adults; therefore, we compared the time needed to use one trap to the time needed to sample and observe 100 shoots. Figure 7 shows that monitoring can be completed in two minutes when using a single trap per field. This is significantly faster than sampling and observing the 100 shoots (Tukey-Kramer, $p<0.0001$).

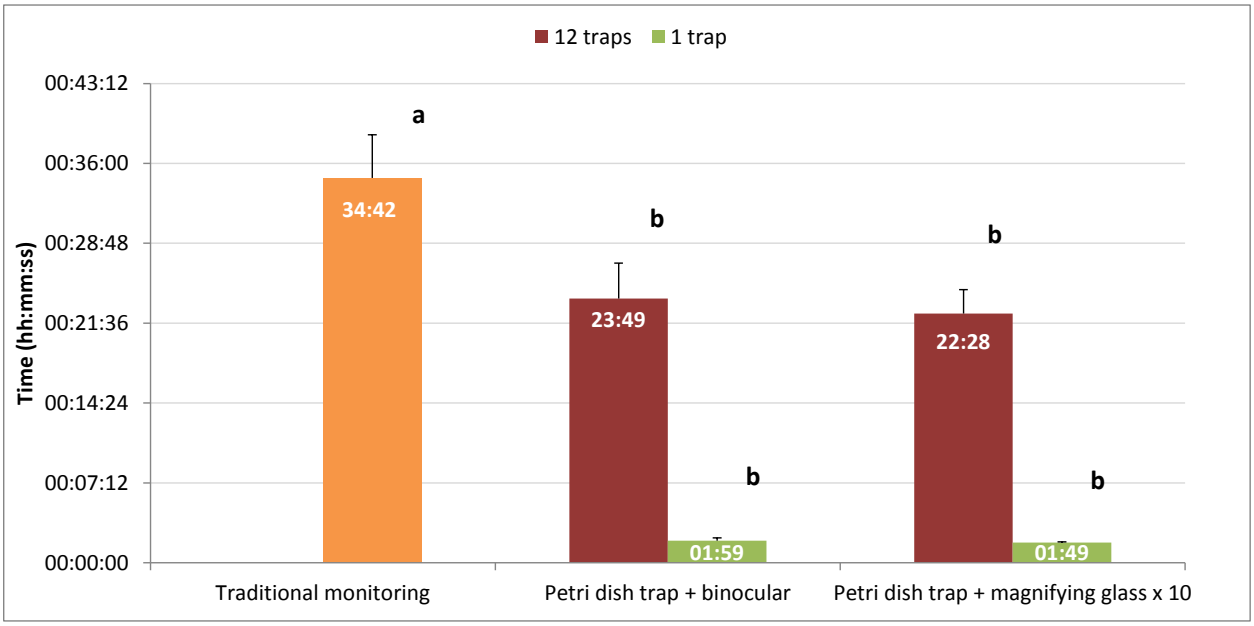


Figure 7. Time needed to sample and observe 100 shoots and time needed to move 1 or 12 Petri dish traps and count *D. oxycoccana* adults using a magnifying glass or a binocular (Different letters above bars indicate a significant difference at α=0,05 with an ANOVA).

The magnifying glass is used most of the time for field work but it is less accurate than a binocular. However, for a small sample, Figure 8 shows that observers did not make significant error when using a magnifying glass rather than a binocular (Wilcoxon, Chi_2=0.5178; p=0.4718).

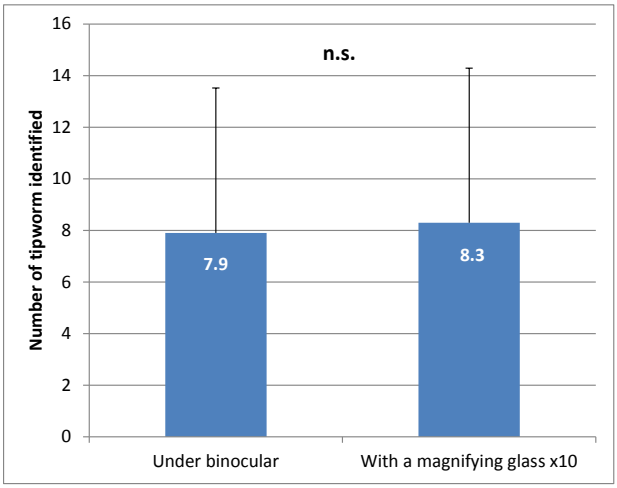


Figure 8. Number of *D. oxycoccana* from the same Petri dish observed with a binocular or a magnifying glass (Wilcoxon test, α=0.05).

Table 6 describes the costs associated with both *D. oxycoccana* monitoring methods. For the Petri dish trap:

- $349.71 is needed the first year to buy the equipment required to build 15 traps and to pay for the human resource to assemble them. The cost for one trap would therefore be $23.31 ($349.71 / 15). Some recurrent expenses increase the cost of the trap to $53.98 but traps can be used over 5 years. In the end, a trap costs $10.79 per year.
-Annually, $47.57 is needed to repair a trap, to place it in the field, to move it and to observe insects glued to the Petri dish. The total cost becomes $10.79 + $47.57 = $58.36 per year.

For the sampling of 100 shoots:

- $12.91 is needed in human resource to sample 100 shoots every week, which represents $193.65 to sample for 15 weeks.
-At $0.05 per week, the cost of materials needed; this means $0.75 for the season.
- Therefore, for 15 weeks of sampling, the monitoring of 100 shoots costs $194.40 per field.

We can conclude that to sample populations of *D. oxycoccana* in one farm, the Petri dish trap costs 3.33 times less annually than the sampling of 100 shoots ($194.40 / $58.36). To sample 20 farms for 15 weeks, $2,722.80 would be saved if using the trap.

Table 6. Cost of two *D. oxycoccana* population monitoring methods (Petri dish trap versus sampling of 100 shoots).

Monitoring	Material	Cost of building 15 traps over 5 years	Amortised cost of building 1 trap over 5 years	Annual material and human cost ($/year)
Petri dish trap	DeWalt drill	69.99		
	Dremel rotary tool	69.99		
	Chuck for rotary tool	9.53		
	Hole saw (Ø 10 cm)	17.50		
	Safety glasses	19.88		
	Stanley glue gun	14.99		
	Kettle	24.99		
	Brush	3.68		
	Tent peg x 3		0.99	
	Rope x3		0.67	
	Perforated copper strap		0.17	
	Wagner paint sprayer	99.99		
	Black bucket		6.00	
	White primer		0.70	
	Human resource ($155/day)-1h to build 1 trap		22.14	
	Black salad bowl			1.37
	Stanley glue sticks			0.21
	Petri dishes (Ø 10 cm) + Tanglefoot®			5.86
	Saw blade	19.17		
	White paint			0.41
	Tape			0.89
	Paint thinner 4L			0.08
	Human resource ($155/day)-30 min to repair 1 trap + 15 min to set the trap in the field			16.61
	Human resource ($155/day)-2 min to move 1 trap + 2 min to smear Tanglefoot® to the dishes x 15 weeks			22.14
	Cost for one trap		23.31	
	TOTAL	**$349.71 $23.31/trap**	**$53.98 $10.79/trap/year**	**$47.57/year**
Sampling of 100 shoots	Ziploc bag x 15 weeks			0.75
	Human resource ($155/day)-35 min to sample 100 shoots x 15 weeks			193.65
	TOTAL for 15 weeks			**$194.40**

Conclusion

- ✓ *For one season, monitoring adults with a Petri dish trap costs $58.36 per field.*
- ✓ *For one season, sampling and observation of 100 shoots costs $194.40 per field.*

3. CONCLUSION

The efficacy of two emergence traps has been tested in cranberry fields in Quebec in 2012. We determined that the Petri dish trap captured higher numbers of *D. oxycoccana* adults and was easier to use than the plate trap. Adults captured in the first trap could predict up to 88% of the variation of larvae observed in the field one week later. We determined that two locations in the field were the most adequate to set the adult monitoring traps all season long. Data from 2000 to 2013 were used to determine the degree days needed to obtain 5%, 50% and 95% levels of *D. oxycoccana* eggs, larvae and adults in the field, for the three generations. Finally, we demonstrated that using the Petri dish trap was 3.3 times less expensive than sampling the 100 shoots. In the short term, agronomists could use the Petri dish trap to monitor adults of *D.*

oxycoccana conjointly with the software CIPRA to predict the presence of eggs, larvae and damages in the field. To provide a strategy to Quebec producers, establishment of an economic injury level for *D. oxycoccana* should be the next step following this project.

4. REFERENCES

Axelsen, J.A. 1992. The developmental time of the pod gall midge, *Dasyneura brassicae* Winn. (Dipt., Cecidomyiidae). J. Appl. Entomol. 114 : 263-267.

Gagné, R.J. 1989. The plant-feeding gall midges of North America. Cornell University Press, Ithaca, NY.

Le Duc, I., M. Roy and J.-P. Deland. 2010. Étude de l'impact de la cécidomyie des atocas et du sablage hivernal sur les plants et les rendements dans la culture de la canneberge biologique. Rapport final présenté au Programme de soutien au développement de l'agriculture biologique du MAPAQ.

Roubos, C.R. and O.E. Liburd. 2010. Evaluation of emergence traps for monitoring blueberry gall midge (Diptera: Cecidomyiidae) adults and within field distribution of midge infestation. J. Econ. Entomol. 103: 1258-1267.