Fine-Tuning Management of Grape Berry Moth

Ontario Grape and Wine Research Inc., Project 000300

Pillar 1

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Final Report
Reporting Period: April 1, 2012- Dec 31, 2012
Submitted: July 17, 2013

Executive Summary:

The US degree day model for grape berry moth was evaluated in three commercial vineyards in 2010-2012. Temperature data was recorded from biofix (50 wild grape bloom) and degree day accumulation determined. Adult flight was monitored using commercial pheromone traps. Egg laying and larval injury were evaluated twice weekly.

A grape berry moth colony was initiated to determine the relationship between bunch rot and moth viability. Contamination with fruit flies caused the colony to crash so this part of the study could not be completed.

The mating disruption part of the project (Objective 4) was not conducted because suitable sites could not be located.

Detailed description of the Project:

a) Objectives and Project Input

1. To improve timing of insecticide sprays for grape berry moth using models developed in the US using female grape berry moth catch, degree day accumulation, and pupation of third generation (based on day length).
2. To improve control of the partial 4th generation of grape berry moth that causes the most significant economic damage by tracking the development of 3rd generation grape berry moth relative to temperature, day length and fruit development.
3. To determine the relationship between bunch rot disease and GBM infestation and also the impact of cluster architecture and microclimate on GBM development
4. To optimize the use of mating disruption for grape berry moth

b) Activities/Methodology

Three commercial vineyards with a history of high grape berry moth pressure and wild grapevine in close proximity to the vineyard were selected for the study. At each site 4-8 rows were left unsprayed for grape berry moth. Temperature loggers and pheromone traps were established in the plots in early May. Wild grapevine was monitored for bloom and when it was at 50% bloom, degree day accumulation was initiated. According to the degree day model, flight should coincide with the accumulation of 450 DD (base 8.3 C). Moths were counted in traps and the incidence of grape berry moth was determined on 100 clusters twice a week. Due to challenges with one of the West St. Catharines sites in 2010, that one was dropped and another block added in Virgil in 2011-12. Daylength data was acquired from Environment Canada (http://www.nrc-cnrc.gc.ca/eng/services/sunrise/index.html).

Virgil Site 1 was a Sangiovese block and Virgil Site 2 was a Vidal block. West St. Catharines Site 1 was a Vidal block.

Results to Date:

Warm spring temperatures in 2010 kick-started GBM earlier than normal so that a large proportion of third generation females laid eggs before August 1st after which day length was less than 14.5 hr (Figure 1 and 2 "Pre-diapause eggs"). Eggs laid before this date when through a full life cycle which gave rise to a full fourth generation, thereby extending the period of activity of GBM later in the growing season. Eggs laid after August 1 developed into larvae then pupated

The growing season of 2011 was more "normal" with respect to GBM development with third generation adult flight occurring after the diapause date of August 2.

The spring of 2012 was warm, promoting wild grape bloom biofix to be early again as it was in 2010. Eggs laid before this date when through a full life cycle which gave rise to a fourth generation, thereby extending the period of activity of GBM later in the growing season. Eggs laid after August 1 developed into larvae then pupated.

Virgil Site 1 (Sangiovese) (Figure 1)

2010

Wild grape reached biofix (50% bloom) on May 28. According to the degree day model, second generation started June 26 (450 DD), third generation July 18 (900 DD) and fourth generation flight on August 11 (1350 DD). Trap catches were low so it was difficult to identify peaks to correlate with the degree day model. However, each predicted generation was associated with an increase in egg numbers and also an increase in injury. A significant proportion of eggs from the third generation were observed before the critical 14.5 hr day length date of August 1. Post veraison egg counts per 100 clusters were about 600. This is a reflection of intense pressure and also a 4^{th} and partial 5^{th} generation.

2011

Wild grape bloom occurred June 8, 10 days later than in 2010. The vineyard reached bloom on June 28, bunch close at July 6 and veraison on August 19. According to the degree day model, second generation started July 11 (450 DD) and third generation started August 6 (900 DD). As in 2010, egg numbers and injury increased following each predicted generation. The number of eggs deposited after veraison was lower in 2011, at 200-300 eggs per 100 clusters.

2012

Wild grape bloom occurred May 29, a day later than in 2010. The vineyard reached bloom on June 8, bunch close on July 10 and veraison on August 8. According to the model, second generation started June 29 (450 DD) and third generation started July 26 (900 DD). The critical 14.5 hr day length date was August 1. A very small proportion of egg was laid by 3^{rd} generation before this date so there was no full fourth generation. Egg numbers and injury increased following each predicted generation. Egg numbers and injury severity were considerably lower than in prior years. This may have been due to more destructive sampling than previously. Trap catches were very low.

Virgil Site 2 (Vidal) (Figure 2)

2011

Wild grape bloom occurred June 7 at this site. Vidal at this site reached bloom on June 20, bunch close on July 22 and veraison on August 16. According to the degree day model, second generation started July 11 (450 DD) and third generation started August 7 (900 DD). Egg numbers and injury increased following each predicted generation.

2012

Wild grape bloom occurred May 25 at this site. Vidal at this site reached bloom on June 15?, bunch close on July 10 and veraison on August 7. According to the degree day model, second generation started June 29 (450 DD), third generation started July 27 (900 DD) and fourth generation started Aug 25 (1350 DD). Egg numbers and injury increased following each predicted generation.

West St. Catharines (Vidal) (Figure 3)

2010

Wild grape reached biofix (50% bloom) May 31. Vidal at this site reached bloom on June 18, bunch close on July 13 and veraison on August 13. According to the degree day model, second generation started July 4 (450 DD), third generation July 31 (900 DD) and fourth generation August 31 (1350 DD). Each predicted generation was associated with an increase in egg numbers and also an increase in injury (Figure 3). Predicted generations matched moderately with pheromone trap catches but not completely.

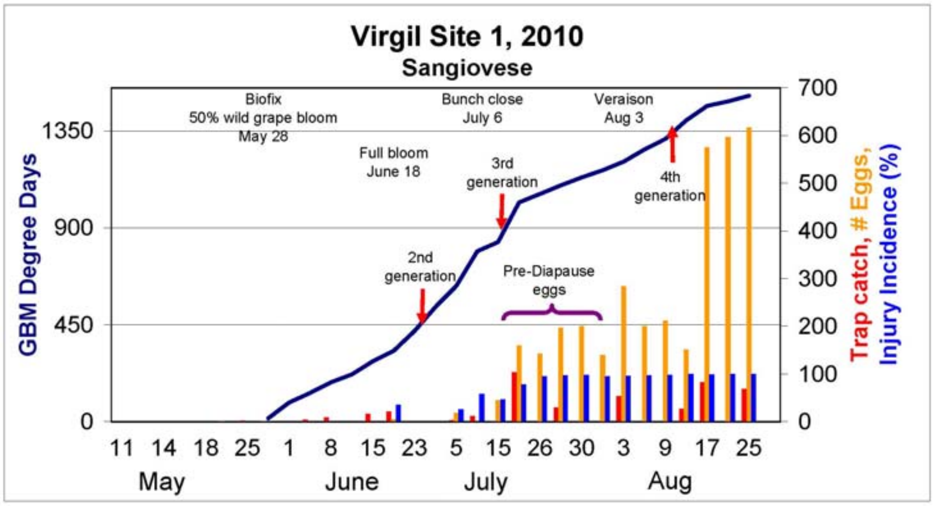
2011 (new site)

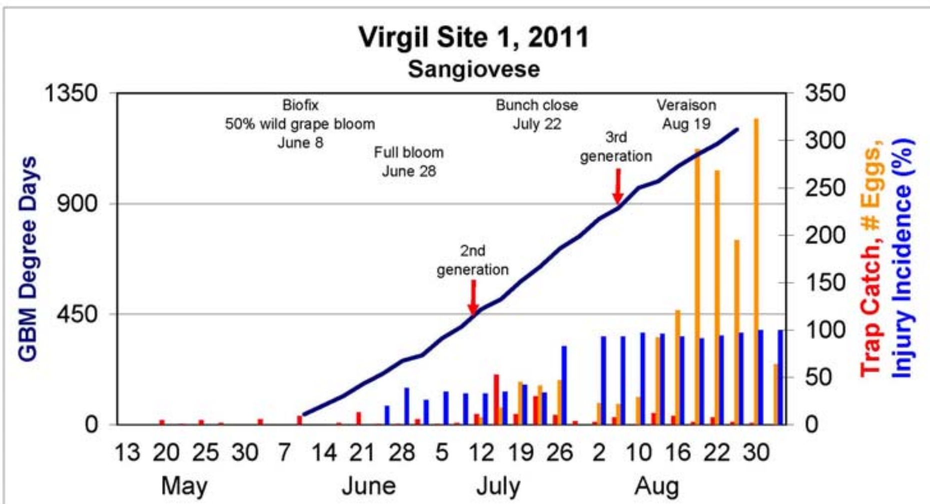
Wild grape reached biofix (50% bloom) June 8. Vidal at this site reached bloom on June 28, bunch close on July 22 and veraison on August 22. According to the degree day model, second generation started July 13 (450 DD) and third generation August 11 (900 DD). Each predicted generation was associated with an increase in egg numbers and also an increase in injury (Figure 2). Predicted generations matched moderately with pheromone trap catches but not completely.

2012

Wild grape reached biofix (50% bloom) June 10. Vidal at this site reached bloom on June 15, bunch close on July 17 and veraison on August 10. According to the degree day model, second generation started July 1 (450 DD) and third generation July 29 (900 DD). Each predicted generation was associated with an increase in egg numbers and also an increase in injury.

Figure 1: GBM Degree Day accumulation, Trap Catch, Unhatched Eggs and Larval Injury Incidence 2010-2012, Virgil Site 1 (Sangiovese)





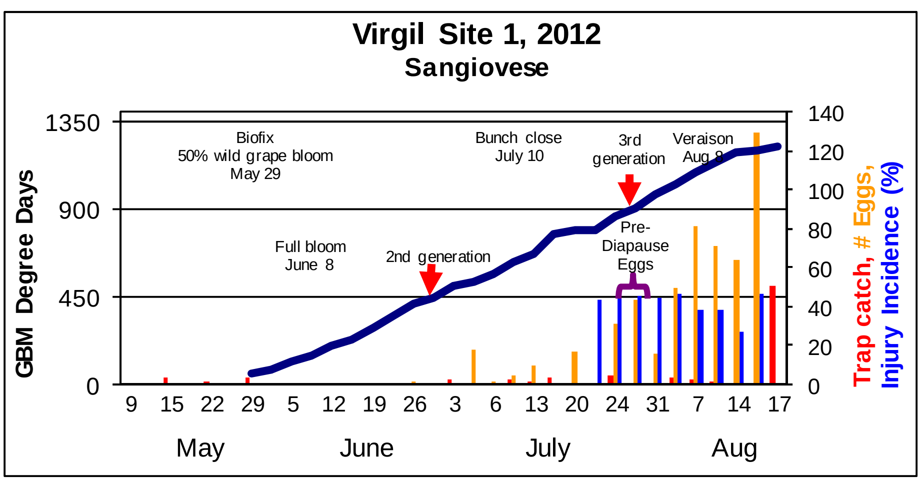
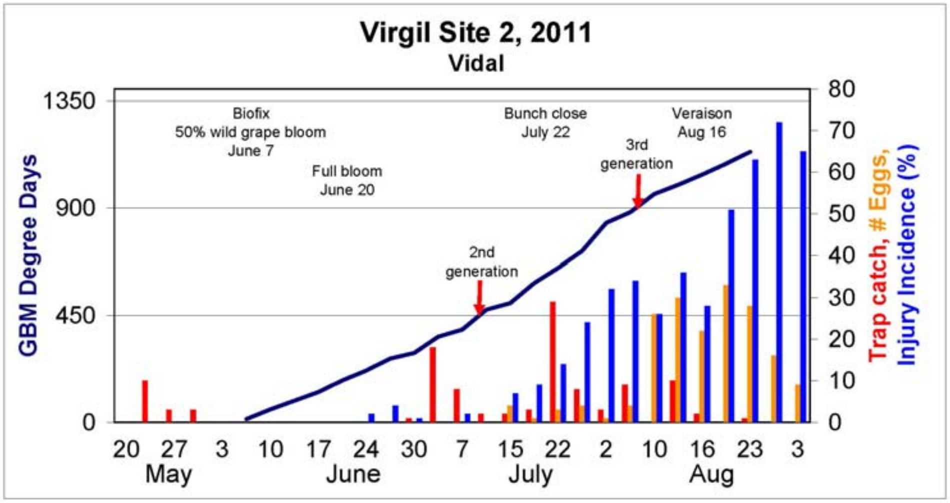


Figure 2: GBM Degree Day accumulation, Trap Catch, Unhatched Eggs and Larval Injury Incidence 2011-2012, Virgil Site 2 (Vidal)



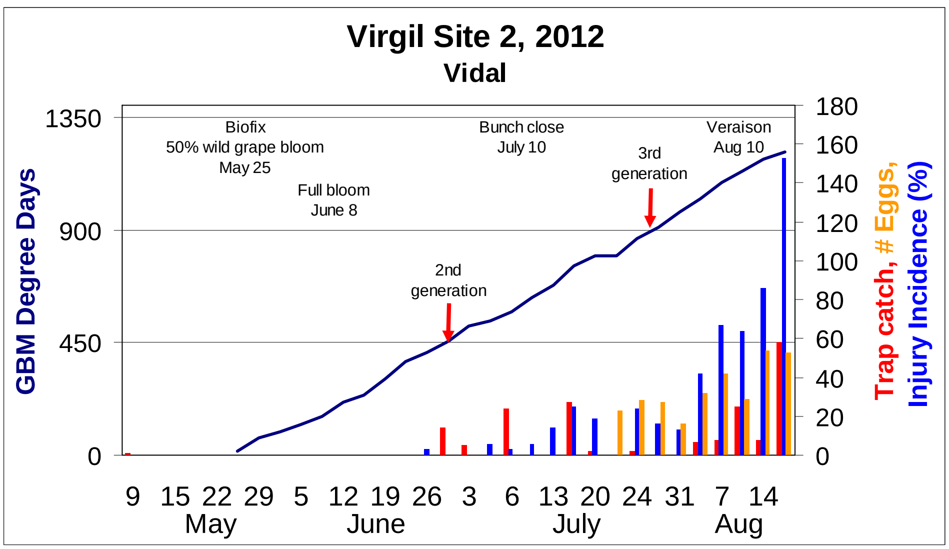
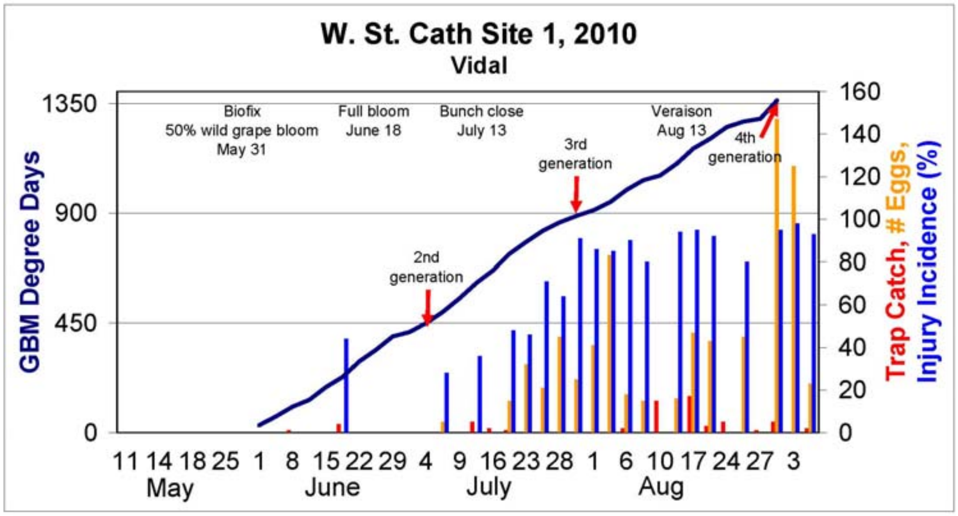
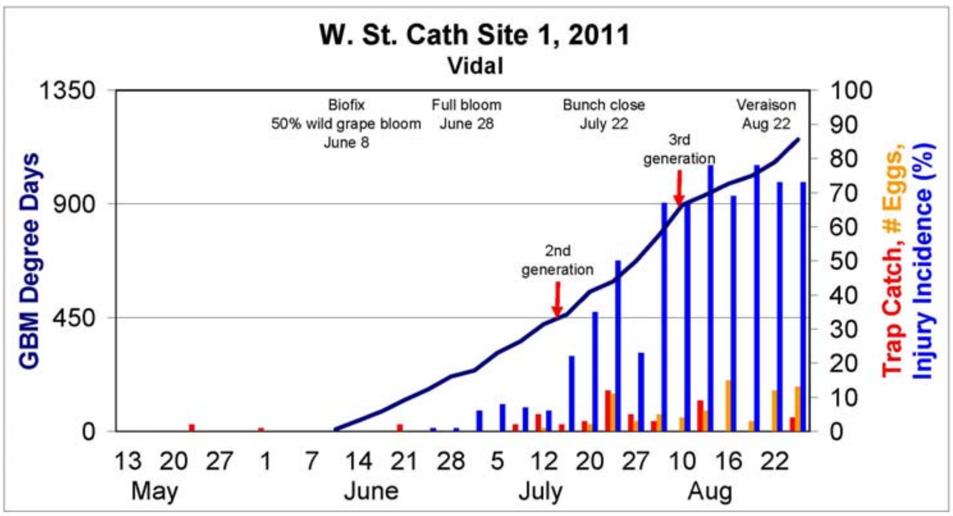
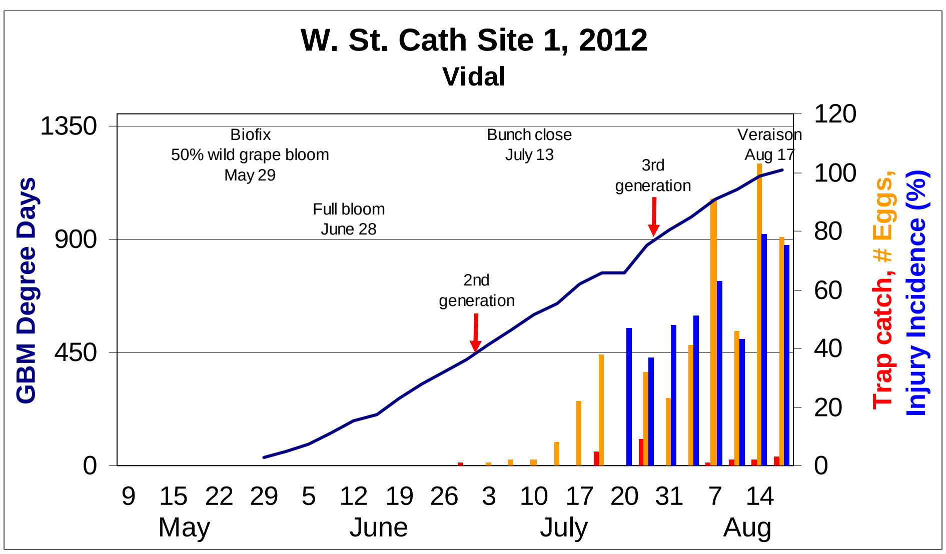


Figure 3: GBM Degree Day accumulation, Trap Catch, Unhatched Eggs and Larval Injury Incidence 2010-2012, West St. Catharines Site 1 (Vidal)







Out Reach and Communications:

A presentation was made at OFVC summarizing the results of the project to date in 2012.

Conclusions and Next Steps:

The predictions of GBM activity matched GBM activity very well with respect to egg deposition and injury. Site-specific trap catches for individual sites give fairly low numbers, at least early in the season, so if the model is successful for the 3 years of the project, it should be adopted in Ontario. The model accurately identified the full fourth generation of GBM in 2010, when there were adequate degree day accumulations to allow a full fourth generation of GBM.

Older insecticide chemistry was timed based on peak trap catch. If a product were applied within 5 days of peak trap catch, it would be effective. Newer insecticide chemistries must be applied earlier, between the time when eggs are laid and when larvae hatch. This is much more difficult to identify based on trap catch, especially for later generations. The model provided reliable information regarding the start of each GBM generation, before the peak that was identified by trap catches. The model can be used to determine when newer insecticides should be applied.

A limitation to the model is the challenge in trying to accurately determine 50% bloom of wild grape. In a single location, there may be several morphologicially different wild grape vines with very different bloom dates. Also, not all vineyards may have wild grape in close proximity. The data will be examined further to determine whether something like Chardonnay bloom could be used as a biofix to initiate degree day accumulation.

Effect of bunch rots on GBM development

Establishment of a GBM colony under lab conditions proved to be challenging as vinegar flies contaminated the colony and outcompeted with developing larvae for food in 2011. In 2012, we attempted to establish a GBM colony by collecting infested clusters and allowing them to develop pupae which were then stored in the refrigerator until vinegar flies were no longer a problem. Very few of the pupae remained viable so the colony could not be established. This aspect of the project was abandoned.

Optimizing mating disruption efficacy

The retirement of Dr. Trimble from AAFC and the inability to identify block suitable to examine reduced mating disruption precluded completion of this aspect of the project.