

**Progress Report To The Viticulture Consortium and New York Wine & Grape Foundation  
January 2005**

**ADDRESSING LATE-SEASON GRAPE BERRY MOTH DAMAGE.**

**PROJECT LEADERS:**

Tim Weigle, NYS IPM Program/Cornell Coop Ext  
Dr. Greg English-Loeb, Department of Entomology, NYSAES, Geneva  
Dr. Michael Hoffmann, NYS IPM Program, NYSAES, Geneva

**COOPERATORS:**

Andrew Muza, County Extension Agent, Lake Erie Regional Grape Program (LERGP)  
Barry Shaffer, Farm Business Management Extension Educator, LERGP

**TYPE OF GRANT:** Biological control and pest biology

**PROJECT LOCATIONS:**

Research results are applicable in vineyards across the eastern and mid-western United States wherever grape berry moth is a concern.

**ABSTRACT:**

The concern over late season grape berry moth (GBM) damage has prompted growers and processors in the Lake Erie region grape industry to take a closer look at the management strategies available to them and the economics of the direct berry damage caused by this pest.

The goals of this project are to look at the parasitic wasp, *Trichogramma ostriniae*, to determine if it would parasitize grape berry moth eggs in the field and to look at the economics of late season losses to this pest and how they relate.

An oversimplification of the 'economics of' GBM damage is whether a load is rejected at the processing plant. While a trailer load of \$200 a ton 'Concords' would result in a loss of \$4,000 it is well understood in the industry that many times this trailer load is taken home, reworked, and passed through inspection on the second try. This project showed that a bigger concern to growers should be in-field loss due to weight-loss from direct feeding on the berry by the GBM larvae, or the premature drop of fruit due to infestation by GBM either alone or combined with Botrytis and secondary rot infections.

**BACKGROUND AND JUSTIFICATION**

Alternative management strategies for grape berry moth have been part of Grape IPM implementation and demonstration projects in New York State since 1990. The Grape Berry Moth Risk Assessment (GBM RA) protocol was developed over ten years ago by Hoffman and Dennehy (1987)<sup>1</sup>. It has since been widely implemented by growers and has been shown to significantly reduce or eliminate insecticide use for grape berry moth (GBM) in a majority of vineyards in the Lake Erie grape growing region. However, in recent years a third generation of grape berry moth has produced late season damage resulting in: 1) loss of crop due to the grapes not being picked for fear of rejection at the processing plant, 2) loss of tonnage by direct feeding on grape berries or 3) rejection at the plant due to exceeding the damage threshold used by area processors. During the 2002 harvest season, numerous processors described in-field losses and the rejection of entire loads at processing plants as the worst in recent history. In response to this problem, researchers, extension personnel and members of the processing industry from the Great Lakes States and Ontario Canada attended a Grape Berry Moth Summit hosted by National Grape Cooperative, Westfield, NY in November 2002 to share knowledge and devise a strategy for combating late season GBM damage. This proposal addresses two of the priorities to come out of the Summit; 1) Alternatives to current control methods for GBM and 2) Development of a guide to the economics of grape berry moth management. A third priority, spray coverage issues, would be reduced and/or eliminated if the use of biological control can be effectively implemented.

Use of biological control could eliminate or reduce the need for late season insecticide applications that 1) have proven to be largely ineffective under new 'Concord' production practices and 2) if effectively delivered to the fruit would produce pesticide residues. Although these insecticide applications are legal under the label and the pesticide residues that remain at harvest are below tolerances established by the EPA, processors run the risk that they are still considered unacceptable by consumers.

We will research the feasibility of using *Trichogramma ostriniae* to control grape berry moth damage in New York State vineyards. *T. ostriniae* is affectionately known as "the Ghengis Khan of natural enemies" by those who know it best. It is cheaply produced, has been shown to disperse rapidly, reproduce in the field, and provide season-long reduction of pest populations. In research conducted in sweet corn over the past 8 years, this wasp has produced remarkably high levels of parasitism (80-100%) of eggs and reduced population levels of European corn borer larvae and tunnel damage to ears by 50%.

Surprisingly, this particular biological control agent is proving to be quite effective in some other agricultural crops as well. Although the conventional wisdom was that *T. ostriniae* was best suited to corn, preliminary studies suggest that grape berry moth eggs in 'Concord' grapes sustained from 35-53% parasitism vs. 2.5% in controls. Exploratory releases in Lake Erie region grape vineyards in 2002 showed up to a 67% decrease in berry damage as compared to companion plots managed using conventional insecticides.

We propose examining the effectiveness of this insectary-reared natural enemy that could solve the problems caused by inadequate spray penetration and coverage, particularly with late season insecticide applications while easily integrating into existing vineyard IPM programs. Approximately 80% of all insecticide applications made in New York vineyards are for control of grape berry moth. If proven effective, *T. ostriniae* could reduce or eliminate insecticide use on the 31,000 acres of grapes in New York State. *Trichogramma ostriniae* is commercially available and no special equipment is necessary for its deployment in the field. Grower risk will be minimized with weekly scouting to quickly determine if damage thresholds have been exceeded and insecticide applications are required.

Results with *T. ostriniae* over the years have been encouraging enough to warrant commercial production. Currently, *T. ostriniae* is available for about \$15.00/30,000 wasps. That price appears to be driven more by market considerations than by production costs, so that, within reason, cost per acre should remain competitive with insecticide sprays, regardless of release rate per acre.

Although grape berry moth is the major insect pest of grapes in the eastern United States, a detailed study on the economic impact of the pest has not been conducted under modern production practices. Moreover, previous research and our current economic threshold have only focused on impact of GBM through fruit contamination, not loss of yield, which could be significant. To fully implement any new strategies against grape berry moth, the economic losses found with the current management strategies must be known. During the GBM Summit II it was stressed that having the ability to determine cost effectiveness of the various treatment methods throughout the growing season was critical to implementing any changes in management practices. Developing economic thresholds based on actual damage/loss at a certain growth stage or growing degree-day accumulation would allow growers to determine their potential loss earlier in the growing season and make the appropriate management decisions.

## **OBJECTIVES**

1. Evaluate the use of *Trichogramma ostriniae* for grape berry moth management.
2. Develop an economic loss potential matrix for grape berry moth to relate damage during the growing season to damage at harvest.

## **PROCEDURES BY OBJECTIVE**

## **Objective 1: Evaluate the use of *Trichogramma ostriniae* for grape berry moth management.**

During the three years of this project the number of vineyards used in this objective went from six in 2003 to thirteen in 2005. All vineyards used for the evaluation of *Trichogramma ostriniae* as an egg parasitoid of grape berry moth had a history of high to severe damage from grape berry moth. Vineyards which received little or no GBM damage during the project (the two Elvira blocks in particular) were eliminated from the project and replaced by another set of vineyards in the following year. Each vineyard was divided into two blocks; one block at ten of the sites had 4 weekly releases of *T. ostriniae*, starting on July 27 and ending on August 14, while the other block was the control and was to be managed by the grower using the Grape Berry Moth Risk Assessment Protocol for scouting and timing of insecticide applications. Due to the reported distribution abilities of this parasitic wasp, blocks within a vineyard were separated by a minimum of 20 rows with only the interior rows of the control used for data collection. Row orientation (parallel or perpendicular to the wooded edge) was taken into account for application of insecticides with vineyards having rows running perpendicular to the wooded edge receiving insecticide to all rows while the vineyard with rows parallel to the wooded edge receiving an insecticide applied only to the outer 6 rows. Releases of *T. ostriniae* were made in a staggered pattern alternating between the second and fifth vines every six to seven rows for those blocks with perpendicular rows and alternating between the middle vine of every third post length on the outside row and the fourth row in from the edge for those rows running parallel to the wooded edge. Mike Hoffmann's lab, Department of Entomology, Cornell University, provided the *T. ostriniae* for this project. Shipments of *T. ostriniae* were overnighted via FedEx to ensure maximum survivability. Release cones used for deploying *T. ostriniae* were similar to those used in 2003 and 2004.

Each pair of vineyard blocks were scouted more intensively than called for by the Grape Berry Moth Risk Assessment Protocol to ensure that grape berry moth populations did not reach devastating levels and results were conveyed to growers for management decisions. Clusters in each vineyard block were examined for grape berry moth damage and evidence of parasitism of grape berry moth eggs in the field. Destructive sampling consisting of 25 clusters from each block started the week of September 23 and continued until late October. Five clusters were selected from the outermost vine in each 5 rows to increase the opportunity of finding GBM egg laying and damage. In the treated blocks, clusters were taken from the rows containing the *T. ostriniae* release cones. Samples in the control block mimicked the treated blocks with clusters being selected from vines from every 6th row.

During September and October, parasitized grape berry moth eggs from the treated and control blocks in North East were sent to Mike Hoffmann's lab for evaluation and possible identification of the egg parasites.

## **OBJECTIVE 2. DETERMINE THE ECONOMIC LOSS POTENTIAL FROM GRAPE BERRY MOTH.**

Monitoring of four vineyard blocks, which were classified as being at severely high risk for grape berry moth infestation, was conducted during the bloom period (direct feeding on the florets), third week of July (ovipositioning stings), third week in August (berry loss due to GBM larval feeding and ovipositioning) and immediately preharvest in 2005. As previously mentioned, with the exception of vineyard blocks that we have begun to classify as extremely high risk, grape berry moth damage was extremely low compared to the recent past so we focused on those severe risk vineyards for this objective to ensure adequate amounts of damage from grape berry moth.

During the immediate preharvest period 110 clusters were collected for each of three replications at each site in 2003 and 2004. Each replication consisted of 10 clusters collected at row 1, 3, 5, 7, 9 and 11 from the wooded edge if rows ran parallel to the woods and where rows ran perpendicular to the woods clusters were collected from vines 1, 3, 5, 7, 9, and 11 from the wooded edge. In 2005 rows, or vines, 13 and 15 were added in an attempt to better understand how far into a vineyard significant GBM damage could be found. Table 1 shows that while GBM damage in interior rows/vines decreases to about half of that found on the wooded edge, it is still much higher than would be expected 15 rows/vines into the vineyard. These clusters were examined for grape berry moth damage, sorted to compare GBM damaged berries from the others in the cluster, and weighed to determine percent loss.

## RESULTS

As in the previous two years of the project, positive identification of *T. ostriniae* as the egg parasite being found in the treated vineyards via in-lab examination was not successful when the parasitized eggs failed to hatch under the same lab conditions that have been successfully implemented with *T. ostriniae* in other crops. Having this occur three years in a row raises the question of whether *T. ostriniae* are able to reproduce using GBM eggs. During preharvest evaluations we consistently found significantly more parasitized eggs as opposed to viable eggs. While this would appear to be a positive result, when the parasitized eggs were held in lab for observation no emergence of any kind was seen. This brings into question whether early releases can lead to a population buildup *T. ostriniae* during the season.

Although we were unable to positively identify *T. ostriniae*, with the exception of one occurrence in 2004, a look at egg parasitism between the paired blocks over the three years provides a good indication that the releases of *T. ostriniae* at the very least augmented naturally occurring biological control agents, especially in the first two years. The 2005 growing season was an extremely difficult year for conducting field trials involving grape berry moth. The hot dry summer would seem to have presented the perfect conditions for grape berry moth populations to explode. On the contrary, while a number of the severe risk sites did have excessive levels of grape berry moth, many of the high-risk blocks had limited egg laying and damage levels so low as to limit differences between control and treated vineyard blocks. The warm weather also presented a challenge as many of the vineyard blocks that, due to the wooded edge, typically have more difficulty with sugar accumulation along with damage from grape berry moth, were harvested early due to attaining the sugar standard early combined with the fear of increased late season damage from GBM. While this was a good management decision by the growers, it removed the crop before evaluations could be made in three of the highest risk blocks. The remaining blocks in this objective had very little egg laying and/or parasitism.

Our hopes that the development of appropriate packing techniques for shipment of berries with parasitized eggs would allow us to positively identify the parasitoids found in the over wintering portion of this project. However, the limited early success of hatching *T. ostriniae* from GBM eggs resulted in our dropping this section of the project in 2005.

The *Trichogramma ostriniae* project was part of the Grape IPM display in the Grape Tent at Empire Farm Days, New York State's largest farm show this past summer and has been part of the discussions at the 2005 Great Lakes Fruit Workers meeting in East Lansing, MI as well as numerous Coffee Pot and IPM Roundtable grower meetings held during the growing season along the Lake Erie Grape Belt.

As in the 2003 and 2004 results, it is apparent that damage from grape berry moth is responsible for a drop in berry size an average of 34.8%. For the third straight year there was also a decrease in the percent damaged berries and percent damage by weight as the collections moved from the wooded edge into the interior of the vineyard, as we would expect. However, traditional wisdom has always been that grape berry moth damage is concentrated in the first two post lengths or first six rows in a vineyard with damage dropping off dramatically after that. While we did see that in more of the vineyard blocks in 2004 and 2005 than in 2003 due to lower overall grape berry moth pressure, others did not follow this trend as shown by the averages in the four vineyards used to create Table 1.

**Table 1. Comparisons of variables to determine economic loss due to grape berry moth in the 2003, 2004 and 2005 growing seasons.**

Vine/Row	% Decrease in Berry Size			% Damaged Berries		
	2003	2004	2005	2003	2004	2005
1	36.4	30.5	38.2	27.7	31.3	24.8
3	38.3	30.8	31.8	20.8	30.9	25.1

5	31.3	25.7	29.1	15.3	22.9	19.5
7	38.7	38.9	36.5	15.7	21.8	13.6
9	35.9	36.7	40.8	11.8	23.3	15.4
11	38.7	28.5	36	11.6	19.1	10.9
13	*	*	40.2	*	*	9.9
15	*	*	36.4	*	*	8.1
<b>Average</b>	<b>36.5</b>	<b>31.9</b>	<b>36.1</b>	<b>17.1</b>	<b>24.9</b>	<b>15.9</b>

Using the averages of percent decreases in berry size and percent damaged berries it is possible to determine how much loss potential there is from direct feeding. Combining results from the three years of this trial provides an average for berry damage from GBM of 19.3%. This amounts to 386 pounds per ton being affected through direct feeding by grape berry moth in the vineyard. The average of 34.8 percent decrease in berry size that comes from direct feeding can be put into the calculation to reveal that an average of 134.3 pounds of grapes, on average, were lost to grape berry moth feeding in project vineyards over the three year. By plugging in the price per ton the grapes sell for into the calculations it is fairly easy to determine economic loss. Even at \$145 per ton grapes would result in a loss of \$9.74 per ton.

### **WHERE DO WE GO FROM HERE?**

Results to this point indicate that *T. ostriniae* can be an important component in an multi-pronged grape berry moth management strategy, especially for growers who are looking for alternatives to conventional insecticides. However, the basic question of whether *T. ostriniae* is able to reproduce using GBM eggs must be determined before this project can move forward in determining better rate and timing information. We will be conducting lab studies during the upcoming year to determine if reproduction using GBM eggs is possible. Once these studies are completed we will have the information necessary to determine the next steps necessary for developing this alternative for grape berry moth management.

### **FUNDING SOURCES**

Viticulture Consortium - East  
New York Wine and Grape Foundation  
Lake Erie Region Grape Processors