Grape berry moth larvae and frass emerge from a maturing berry. GBM is in Texas, Michigan, New York and Pennsylvania among other states.

Tracking Grape Berry Moth in the South

Texas adapts prevention methods and pesticide treatments used in the north and east

By Fritz Westover

The rapid expansion of the Texas wine and grape industry has brought with it an ever-increasing list of pest and disease pressures as vineyard production is pushed into newer areas of the state. One pest, the grape berry moth (*Paralobesia viteana*), has been identified in much of the state of Texas—including the central Texas Hill Country, the eastern, northeastern and Gulf Coast regions of the state—and has been particularly problematic in vineyards planted near heavily wooded areas where dense stands of native grapevines are established.

The damage caused by grape berry moth (GBM) is similar to that reported in other states with a long-standing history of this pest including Maryland, Michigan, New York, North Carolina, Pennsylvania and Virginia.

Wine East HIGHLIGHTS:

- Grape berry moth, which consumes the flesh of young berries and allows them to rot, affects many of Texas' vineyard regions.
- Protocols from cooler climates have helped develop programs in Texas. However, the temperature extremes require adaptation.
- Accurate timing of treatments is critical, and proper timing may allow southern growers to use much less insecticide than elsewhere.

The moths emerge from pupae in the spring, roughly about the time of bloom. They mate and female moths deposit eggs on young grape clusters. A new generation emerges from those eggs as tiny larvae, which pierce directly into developing berries, often consuming the flesh of several berries before they mature and pupate, beginning a new generation of moths.

Infested berries can decrease fruit quality by directly damaging berries within clusters and may cause additional damage if spoiled berries become source points for late-season rot complexes during wet seasons. As with other states, there are several generations of the GBM within a single growing season in Texas and, with the help of the Texas A&M AgriLife Extension service, growers are learning how to monitor and control this pest in a southern climate.

Grape berry moth in a hot climate

Most of the methods to help growers control GBM have been developed in

cooler northeastern states such as New York, Pennsylvania and Michigan, where this pest is known to affect both wine and juice grape varieties. Much of the past research has been aimed at determining the best time to apply insecticides to target eggs and larvae. Researchers in those states have developed degree-day (DD) models that use either a fixed calendar date or a "biofix" date (such as bloom of native grapevines) to determine the starting point to accumulate DDs.

Degree-days are most commonly calculated for GBM by using a minimum temperature threshold or "base temperature" of 47.1°F (8.41°C) developed by researchers at Penn State.[4] Daily DD accumulation is calculated by averaging the daily high and low temperatures and subtracting the base temperature. Growers are encouraged to record DDs from the biofix date until harvest.

One or more methods are utilized by growers to predict GBM activity in the vineyard. If the grower wishes to apply an insecticide to treat the first generation of moths, he or she can predict the emergence by the capture of male moths in sticky traps containing the sex pheromone of the female GBM.

The eggs that are deposited on berry clusters are also a useful indicator of a new generation increasing in population. However, the eggs are small (about 1mm in diameter), transparent and very difficult to detect by the untrained eye. Berry infestation is a bit easier to see, although it is best to treat the potential problem before berry infestation occurs.

In the Texas Gulf Coast region, the first male moths *(above)* are trapped as early as April.

Due to these factors, growers often use a combination of DD predictions and physical trap catch data to determine when the emerging generation is entering vineyards in the spring and estimate the peak populations of successive generations. For example, the suggested range of DD from 50% bloom of the wild grape *Vitis riparia* to the peak in egg laying by the second generation of GBM is about 810 DD in New York.[5] But is the second generation a major target for insecticides in Texas?

The protocols developed in cooler climates offer a useful starting point for growers to develop management programs in hot climates such as Texas. However, the extremes in temperature must be taken into consideration when estimations of GBM activity are predicted.

Laboratory work by researchers at Penn State University established an upper threshold of 93.2°F (34°C) for activity of eggs and larvae.[4] For example, temperatures rarely are greater than 93°F for long stretches of time in the northeastern United States, but it is not uncommon to experience temperatures higher than 93°F for more than 15 days per month during the latter part of the growing season in Texas (June-August.) This may result in significant decreases in the severity of infestations in hotter versus cooler years in Texas, which growers could translate into increased savings of insecticide treatments during hot summer months.

Texas research

A 2007-09 field study conducted by Texas A&M Extension and Research in five commercial vineyards in the Texas Gulf Coast region showed that the first emerging male moths are trapped as early as late April,

with the peak of the emerging generation occurring by the first or second week of May. A second, less-populated generation of moths occurred in mid- to late June, and little or no activity was observed in traps or clusters in late June through July. GBM activity appears to drop off during the hot summer months, and therefore the bulk of insecticide treatments in Texas are targeted toward the first emerging generation in the spring.

While pheromone traps are long retired by growers after harvest, this does not suggest that GBM is not active during the postharvest period in the south. Secondary clusters that are generally hard and green during harvest will often be found with GBM infestations in August and September, which suggests that a small population is surviving the summer heat and producing a possible third and fourth generation.

Larvae from these secondary cluster infestations were sent to Penn State University to be included in a multi-state evaluation of diapause in GBM, which is essentially the onset of the dormant stage in which the insect remains in its pupal form for a period of time (during the winter.) Diapause is thought to help with winter survival and is brought about by subtle environmental cues such as changes in day length.

A small population is surviving the summer heat and producing a possible third and fourth generation.

Interestingly enough, the Penn State study showed that populations of GBM experiencing longer day length during the post-summer solstice in the south (Arkansas, Texas, Virginia) responded differently than populations from the northeast (Michigan, New York, Pennsylvania), indicating that GBM may remain active year-round at some latitudes found in the Gulf Coast region,[3] although this has not been documented.

As mentioned above, the behavior of GBM appears to differ in hot climates. The extended warm period and greater DD accumulation found in southern grapegrowing regions would lead scientists to presume that there are a greater number of GBM lifecycles. However, the temperature is often too hot to favor activity of developing eggs and larvae for many of the mid- to late summer months.

Furthermore, many grape varieties ripen very quickly in the Texas climate, which translates to less exposure to multiple generations of moths. For example Blanc Du Bois, the major white grape variety in the Gulf Coast region, ripens about 110 days after bud break, on average. This suggests that for an early season variety, if a single,

Sticky traps are baited with pheromones from the female grape berry moth.

well-timed insecticide is applied thoroughly in the fruit zone for the first generation, season-long control could be achieved in hot seasons.

Research by Michigan State University has demonstrated that a single application of methoxyfenozide (Intrepid 2F, Dow Agro-Sciences) applied with a surfactant and excellent coverage can provide effective control to grape clusters for more than two months.[2] Should similar insecticide longevity be found in hot climates, the reduction in insecticide use from the above strategy could result in both economic and environmental benefits.

An insecticide timing trial was conducted in the five commercial vineyards in the Texas Gulf Coast region during the 2009 season to determine the best time to apply methoxyfenozide for season-long control of GBM. The results showed that season-long berry infestation was reduced the most by applying methoxyfenozide within 7 days of the first male moth capture in pheromone traps along the vineyard edge. Waiting as long as 14 days resulted in about a 50% reduction in season-long infestations compared to later or untreated clusters, although the earlier application was significantly better.

We noted in the three-year trapping study between 2007 and 2009 that Blanc Du Bois clusters had approximately BB-size berries when the first moth

A single grape berry moth larva infests two berries *(left)*, while a whole cluster *(right)* is under attack from several immature GBM.

activity was recorded, which indicated that cluster phenology could also be useful as an indicator of when to apply the first insecticide.

Grapegrowers in some of the hottest counties in the Gulf Coast region of Texas have since adapted to using a combination of phenological cues and pheromone trap catch data to time the first insecticide application for the season and have gone from three to four GBM insecticide treatments per year to just one or two.

Future strategies for GBM control

Several new products are available for the control of grape berry moth in vineyards. As history has shown, repeated use of one chemical can lead to possible resistance development by the pest. Researchers in New York and Pennsylvania discovered this phenomenon with repeated application of carbaryl insecticide.[1] Growers are encouraged to rotate insecticide products with those having a different mode of action group as noted by the Insecticide Resistance Action Committee (IRAC.)[6]

> *Insecticide use for control of GBM would perhaps be much less than is required in cooler climates.*

In Texas, growers are encouraged to continue using pheromone traps in conjunction with phenological cues such as berry size to determine the best time to apply treatments. Degree-day accumulation may serve as an additional

tool for tracking GBM emergence in the spring and may even replace the need for pheromone trapping. However, there is still work to be done to identify the best practices for accumulating DDs in the south. Protocols in New York suggest starting at bloom of the wild grape variety *Vitis riparia* as the "biofix" to start accumulating DDs. There is an effort by Texas A&M AgriLife Extension to accumulate DDs starting at the time of bud break of the common own-rooted Blanc Du Bois grape in the Gulf Coast region. Wild grape varieties such as the Mustang grape (*V. mustangensis*), which is found in most of the Gulf Coast, could be explored for their use in starting DD accumulation, depending on the location. In areas of the state where GBM is the primary pest of concern, using insecticides specific to *Lepidoptera* (moth species) can greatly decrease the use of broad-spectrum insecticides. In general, insecticide use for control of GBM would perhaps be much less than is required in cooler climates. WE

References

1. S. Nagarkatti, P. Tobin, A. J. Muza and M. C. Saunders. 2002. "Carbaryl resistance in populations of grape berry moth *(Lepidoptera: Tortricidae)* in New York and Pennsylvania." *J. Econ. Entomol.* 95 (5): 1027-1032.
2. L.A.F. Teixeira, K. Mason and R. Isaacs. 2009. "Control of grape berry moth *(Lepidoptera: Tortricidae)* in relation to oviposition phenology." *J. Econ. Entomol.* 102 (2): 692-698.
3. J. Timer, P.C. Tobin and M.C. Saunders. 2010. "Geographic variation in diapause induction: the grape berry moth *(Lepidoptera: Tortricidae.)*" *Environ. Entomol.* 39 (6): 1751-1755.
4. P.C. Tobin, S. Nagarkatti and M.C. Saunders. 2001. "Modeling development in grape berry moth *(Lepidoptera: Tortricidae.)" Environ. Entomol.* 30 (4): 692-699.
5. grapesandwine.cals.cornell.edu/appellation-cornell/issue-3/gbm-forecast.cfm
6. irac-online.org/

Fritz Westover *is a viticulture program specialist at Texas A&M. In addition to his duties in the Texas Gulf Coast region, Westover supervises three extension program specialists as part of a statewide team effort to provide educational programs and hands-on viticulture workshops for the Texas wine industry.*