Testing the Use of a Degree Day Model to Time Control of Grape Berry Moth

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Abstract:
The goal of this two-year study is to validate the use of a temperature-driven phenology model to time the application of insecticide for the control of grape berry moth (GBM), the key insect pest of grapes in the eastern United States. This multi-state project used replicated plots in vineyards in the Finger Lakes and Lake Erie Regions of New York, the Lake Erie Region of Pennsylvania and the Southwestern region of Michigan. This report details first year results from the Lake Erie region of New York. The use of a temperature driven Phenology model to time insecticide applications for grape berry moth resulted in a decrease in the number of applications from three to two when compared to the conventional timings provided by the Grape Berry Risk Assessment Protocol.

Background and Justification:
Grape Berry Moth (GBM) is the key insect pest of grapes in the eastern United States due to loss from the larval stage feeding directly on developing berries and also to loss associated with secondary rots that use the feeding wounds as an avenue for berry infection. The Grape Berry Moth Risk Assessment (GBMRA) Protocol developed by Hoffmann and Dennehy in the late 1980's has become the conventional means of grape berry moth management in New York State. (A complete description of the protocol can be found at: http://nysipm.cornell.edu/publications/grapeman/files/risk.pdf The GBMRA protocol worked well for many years. However, late season damage started to become a problem in the late 1990s and the GBMRA has proved to be less effective at determining the need for later season applications. With the first spray based on the timing of the bloom period, which is driven by temperature, the other spray timings are based on calendar dates with no correction in years that are much warmer or colder than average. The degree day (DD) requirements (use of daily high and low temperatures to determine heat accumulation) for development of each generation of grape berry moth has been investigated under laboratory conditions (Tobin et al. 2001, 2003). Based on these data we estimated that the number of degree-days for GBM to develop from eggs to egg-laying adult females is approximately 810 DD (^{0}F) using a base temperature of 47 ^{0}F. Using bloom date to start the collection of DD, a phenology model would predict the start of the second generation at 810 DD after bloom and the third generation at 1620 DD after bloom. This model has been tested at a few isolated sites but has not undergone evaluation under commercial vineyard conditions.

Objective:
Compare effectiveness of Grape berry moth control in multiple states when timing is based on a degree-day phenology model verses the calendar based Grape Berry Moth Risk Assessment Protocol.

Procedures:
Experiments will be conducted at vineyard sites each in New York (Finger Lakes and Lake Erie regions), Pennsylvania (Lake Erie region), and Michigan (Southwestern region), using Labrusca or hybrid vineyards with a high risk of GBM damage. At each site we will establish six-vine plots located at the vineyard edge where GBM pressure is greatest using a random block experimental design and 4-6 replicates per treatment. Treatments compared in this experiment will be: 1) treated with GBM insecticide following GBMRAP at 5-10 day post bloom, beginning of August, and end of August (commercial standard), 2) treated with GBM insecticide following GBM phenology model of Tobin et al. (2001) at 810 DD (°F) after biofix (bloom of the wild grape *V. riparia*) (predicted start of second generation), and 1620 DD (°F) after biofix (predicted start of third generation) and 3) untreated control.

Damage from GBM larvae will be evaluated three times during the growing season at each site (approximately mid-July, mid-August and before harvest). For each damage assessment we will examine 10 clusters from each of 5 vines in the center of a plot for percent cluster infestation and total number of damaged berries. We will also assess female egg-laying activity through time by monitoring new stings on 100 marked clusters in unsprayed parts of the vineyard at least once per week starting in early July through mid-September. Prior to harvest, 25 clusters in the three central vines of each plot will be collected and weighed to determine whether yield varies among treatments.

Results and Discussion:

Two 'Concord' vineyards were initially involved in the project n the Lake Erie Region of New York State. Unfortunately one of the vineyards was hit by a spring frost event followed up by a hail storm in July. Between these two weather events enough crop was removed or damaged to make it unsuitable for further experimentation.

The second 'Concord' vineyard was spared both of these weather events and was managed using commercial practices for vine nutrition, weed and disease management. Dormant pruning was accomplished to produce an average crop size across the experimental block. Five replications of six vines each were used for each treatment in a randomized complete block design. The end vines of each treatment replicate were used as a border vine (no count) to ensure there was no treatment overlap in vines where data was collected. Bloom in the commercial vineyard block was recorded on June 14, 2009 with wild grape bloom observed on June 7, 2009.

The first insecticide was applied in accordance with the GBMRA protocol in the GBMRA vines on June 27, 2009. A second insecticide application was made to the GBMRA vines on July 28, 2009. Using the wild grape bloom date of June 7 as the biofix

to start recording Degree Days. Using 810 DD as the timing of the first insecticide resulting in an application being made on July 16. A second application for the phenology treatment and a third application for the GBMRA treatment was applied on September 2, 2009. This timing was a bit late due to some scheduling problems as 1620 DD after the biofix date was achieved on August 25, 2009.

The GBMRA protocol calls for scouting vineyards during the third week of July and the third week of August. A treatment threshold of 6% damaged clusters is used during the July scouting period while the treatment threshold is increased to 15% damaged clusters during the August scouting. It is important to remember that a cluster is considered damaged whether it has a single or multiple berries with grape berry moth damage.

As you can see in Table 1 the treatment threshold was exceeded in all of the treatments during both the July and August scouting periods although the temperature driven phenology model treatments had lower damage levels at both timings than the no insecticide control treatment or the GBMRA treatment. Both the Phenology and GBMRA treatments had received a single insecticide application prior to the July scouting with the GBMRA vines getting the traditional post bloom application (June 27) while the phenology model vines did not have insecticide applied until July 17.

Table 1. GBM damage for 'Concord' vines not treated with insecticide, treated according to risk assessment protocols, or treated according to a temperature-driven phenology model.

Treatment	July 23		August 18		September 16		October 7	
	Stings/ Cluster	%Cluster Infestation	Stings/ Cluster	%Cluster Infestation	Stings/ Cluster	%Cluster Infestation	Stings/ Cluster	%Cluster Infestation
Control	0.48	9	1.88	28	5.96	98.4	9.6	100
GBM RA	0.64	13	1.48	21.5	5.97	91.2	5.8	98
Phenology	0.36	7.5	0.94	17.5	5.09	91.2	5.4	90

The number of clusters with grape berry moth damage reached 100% in the Control treatment by the October 7 harvest date. The Phenology model showed both lower %cluster infestation and average number of stings per cluster over the other two treatments. These first year results indicate that there is the potential for insecticide use in vineyards classified as being at high risk for damage by grape berry moth to be reduced by one-third using a temperature driven phenology model. Further testing is needed to determine if more rigidly following the 1620 DD for the timing of the second Phenology model insecticide application would result in even further decreases in damage.

Project location:
Lake Erie Region of Western New York