Progress Report to Lake Erie Regional Grape Research and Extension Program Inc., and New York Wine & Grape Foundation

MANAGING GRAPE ROOTWORM IN NY VINEYARDS

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INTRODUCTION

Historically (early 1900s) grape rootworm (GRW) was the major insect pest of grapes growing in New York and surrounding states (Johnson and Hammar 1910). Adults do some minor leaf feeding in early to mid-summer. However, larval feeding on grape roots can reduce vine vigor or even cause vine death at high densities. For various reasons, including the seasonal use of broad-spectrum synthetic insecticides, the pest status of GRW declined during the second half of the 20th century. However, with the advent of more selective insecticides and the overall reduction in the number of applications during the season, reports of GRW adult feeding damage have greatly increased in recent years, especially in the Lake Erie Grape Belt. Because adults and their feeding damage are not obvious and larvae are pretty much hidden, it's likely that the impact of GRW is greatly under estimated by New York grape growers. Insecticide, targeting adult GRW during the pre-oviposition period (time between when adults emerge from soil and the start of egg laying), is the recommended method of control.

METHODS

This was the second year of a multi-year project examining the need for managing grape rootworm populations, the optimal timing of insecticides for control of grape rootworm and the use of entomopathogenic nematodes (a biological control used successfully for alfalfa snout beetle) against grape rootworm larva. This was done through 3 objectives.

Objective 1. *Determining optimal timing of insecticide control of adult grape rootworm.*

The cooperation of four growers allowed us to set up our experiment in nine vineyard plots located in the Lake Erie region with a history of GRW problems. Five of the vineyards were managed using scouting to time insecticide applications against grape rootworm adults while the remaining three blocks received no insecticide applications and acted as controls. Weekly scouting started in the first week of June, earlier than GRW should be present in the vineyard, in both years to allow the recording of first emergence. Scouting was conducted in every 4th, or 6th, row depending on block size. A 2 foot square catching frame constructed of wood 1x4's covered in muslin cloth was placed under the middle vine and the top wire vigorously shaken to dislodge any grape rootworm adults in the canopy. Any adults captured were recorded and kept for use in potted study. This was repeated for every other post length for the entirety of the row. Catch information was relayed to cooperators on a weekly basis to assist in the determination of the need to apply an insecticide. Scouting results were used in combination with weather information from Network for Environment and Weather Applications (NEWA) stations in Portland and Ripley to start collecting the baseline information for development of a degree day model for timing of GRW scouting.

Objective 2. *Assessing vineyard productivity in response to insecticide control of grape rootworm.*

The participating vineyard blocks are assessed annually using NDVI (Normalized Difference Vegetation Index) sensors mounted on either a grower's tractor, or on a John Deere Gator operated by LERGP, staff starting in 2015. This information is then compiled into maps by Rhiann Jakubowski, LERGP. This was done for both the treatment and control vineyards involved in the project to allow for comparison of changes in vine size due to treatment/no treatment of grape rootworm populations that may occur over time.

Objective 3. *Assessing the efficacy of entomopathogenic nematodes against larval grape rootworm.*

We used 20 Concord vines potted in 5-gallon pots with vineyard soil to test the efficacy of a mixture of three species of entomopathogenic nematodes known to cause mortality to beetle larvae against larvae of GRW. The three nematode species are *Steinernema carpocapsae*, *S. feltiae* and *Heterorhabditis bacteriophora* and were supplied Dr. Elson Shields. The trial was comprised of three treatments and a control with treated pots receiving a mixture of nematode species at a rate of approximately 100,000 infective nematodes per pot. During scouting of the infested vineyards, adult GRW were to be collected and caged on the 20 potted vines (10 adults per pot). The vines were watered and fertilized during the growing season as needed.

RESULTS

Objective 1. *Determining optimal timing of insecticide control of adult grape rootworm.*

The vine shaking method used to capture adult GRW proved to once again be successful in monitoring for the presence of grape rootworm adults. Adult GRW were collected from vines by placing a catching frame under the middle vine of a post length and then giving the top wire a vigorous shake to dislodge the GRW. Any adults in the canopy fell from the vine and onto the catching frame where they were recorded and captured for use in the potted vine study.

As seen in Table 1, the 2015 - 2016 growing seasons showed a much earlier peak emergence than the July 4th weekend traditionally used for timing of scouting. It is apparent that if the traditional timing for scouting and treatment were still being used a majority of the population would have mated and laid eggs prior to control measures being applied. It is interesting the emergence period for grape rootworm adults was quite short (3 weeks) in 2016 compared to the eight week time frame seen in 2015. The Lake Erie region did experience drought conditions through much of the 2016 growing season which may have played a role in the limited emergence period.

Table 1. Comparison of grape rootworm adult emergence by date and growing degree day for the 2015 and 2016 growing seasons using the Portland NY (CLEREL) NEWA station.

			January DD		April DD	
Emergence	Date 2015	Date 2016	2015	2016	2015	2016
First	June 10	June 21	642	761	642	714.5
Peak	June 17	June 21	784.5	761	784.5	714.5
Last	August 8	July 6	1778.5	1073.5	1778.5	1027

Two years of weather data is not enough to develop a degree day model with any measure of confidence, but we have started to compile the database of information. As more data is collected over the years, we will be looking at the potential to refine a degree day model for emergence by increasing the number of collections to cover the time frame of predicted first emergence. This will help to tighten up the range of degree days and remove some of the error present when scouting is done only on a weekly basis.

The growing degree days for Table 1 by taking the average growing degree day from our Network for Environment and Weather Applications (NEWA) weather station in Portland, NY. We are also using the NEWA station in Ripley, NY to provide weather information for the vineyard blocks in that region.

Objective 2. *Assessing vineyard productivity in response to insecticide control of grape rootworm.*

All participating vineyard blocks are being scanned on a yearly basis to develop canopy maps using the NDVI (normalized difference vegetation index) protocol being developed by Dr. Terry Bates at CLEREL. The scans are being conducted at approximately the same timing, just before peak emergence, each year. Rhiann Jakubowski, LERGP GIS Mapping/Sensor Technology technician, produces maps from the scan data to allow year to year comparisons of the range of relative vine size found in the vineyard block. Without validation using dormant pruning weights these maps do not provide information on whether vine size is large or small. However, these maps can be used as an indication of whether or not the management strategies applied for grape rootworm are having an impact on improving vine size, or at least making vine size more uniform across the block. In Figure 1, the yellow and orange areas on the on the left side of the maps indicate vines with smaller canopies (vine size) relative to the vines in the green and blue areas (blue indicates the highest vine size). In this example it appears that the size of the area showing the effects of root feeding by grape rootworm has decreased in a single season. Continued canopy mapping using NDVI will assist in determining the effectiveness of grape rootworm management practices.

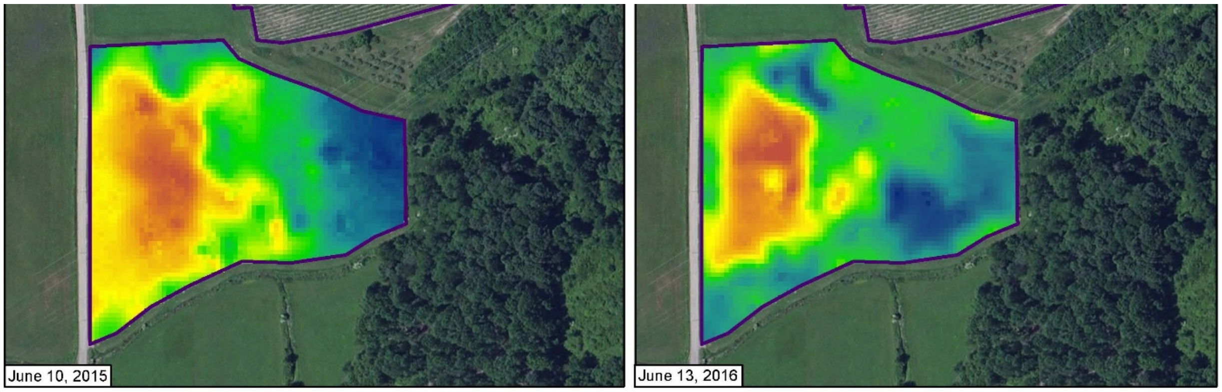

Figure 1. Comparison of vine size uniformity between years in a participating vineyard block that is being treated for grape rootworm as part of the project. Notice the decrease in the orange and yellow areas that represent relatively smaller vine size after one year of insecticide applications.

Objective 3. *Assessing the efficacy of entomopathogenic nematodes against larval grape rootworm.*

Due to the condensed time frame of emergence, and the small overall population of captured adults needed to "seed" the pots, we were unable to complete this objective in 2016.

Environmental Impact Quotient

The Environmental Impact Quotient (EIQ) was developed in 1992 by Kovach, et al as a way to organize environmental impact data into a form that would allow growers a method to easily assess, and take into consideration, the impact of their pesticide choices on farm workers, consumers, and the environment. There are limited choices available for management of grape rootworm and they are all focused on management of the adult phase of the lifecycle. For many years the only active ingredient that was labeled for use against grape rootworm was Sevin (carbaryl). An earlier project by Loeb and Weigle resulted in FIFRA 2(ee) Recommendations being available for another four materials with different modes of action; Admire Pro Systemic Protectant (imidacloprid), Danitol 2.4EC (fenpropathrin), Leverage 360 (imidacloprid & beta-cyfluthrin), and Sniper (bifenthrin). All of these active ingredients, including carbaryl, meet the EPA criteria for acute toxicity to bees.

Table 2 Field EIQ rating of pesticides labeled for use against grape rootworm as well as the rating for the consumer, worker and ecological components.

Insecticide	Rate/Acre	Field EIQ	Consumer	Worker	Ecological	Active Ingredient
Admire Pro	1.4 fl oz	1.4	0.4	0.3	3.5	imidacloprid
Danitol	10 fl oz	4.9	0.4	1.2	13.1	fenpropathrin
Leverage[1] 360	3.2 fl oz	1.5	0.4	0.3	3.7	imidacloprid
		0.7	0.1	0.1	1.8	beta-cyfluthrin
Sevin XLR	2 qt	40.1	9.7	2.5	84.1	carbaryl
Sniper	3.2 fl oz	2.2	0.4	0.7	5.6	bifenthrin

[1] Leverage 360 combines two active ingredients, imidacloprid and beta-cyfluthrin and therefore has two EIQ ratings.

In 2016 two of the blocks received two insecticide applications, one aimed specifically for grape rootworm and the second targeting both grape rootworm and grape berry moth. Three of the project blocks received only one insecticide that was timed for grape rootworm after scouting indicated management was needed.

Table 3. Comparison of Total Field EIQ rating for the different grape rootworm insecticide programs in 2016.

Block	Date of Application	Material	Rate per Acre	Field EIQ	Total Field EIQ
1	6/23/2016 7/7/2016	Sevin 4F Sevin 4F	2.0 quart 1.5 quart	39.1 22.7	61.8
2	6/3/2016 7/9/2016	Sniper Leverage 360	3.2 fluid ounces 3.0 fluid ounces	2.2 2.0	4.2
3	6/13/2016	Leverage 360	3.2 fluid ounces	2.2	2.2
4	6/11/2016	Leverage 360	3.2 fluid ounces	2.2	2.2
5	6/11/216	Leverage 360	2.5 fluid ounces	1.6	1.6

While Admire Pro has the lowest EIQ of the labeled materials, and is recommended as being the low cost alternative for grape rootworm management, it was not used by any of the growers in this project primarily due to its active ingredient being active only against grape rootworm and no other primary or secondary pest present at the time of the application. Another factor is that there is a limit of 2.8 fluid ounces of imidacloprid applied to foliage in a season. Since imidacloprid is also found in broader spectrum products like Leverage 360, which is also used to manage grape berry moth, an early season Admire Pro for grape rootworm would limit options for grape berry moth later in the season.

It is apparent that while the four new materials that are available through FIFRA 2(ee) recommendations add new modes of action for resistance management, they all have significantly better EIQ ratings than the previously standard carbaryl treatment.