

FARMER/GROWER GRANT REPORT

1. Project name and contact information

Project title: Control of Grape Root Borer

Project number: FNE03-471

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2. Goals

Little work has been done on grape root borer in Pennsylvania. Several methods are available to trap and enumerate the adult male grape root borer moth with pheromone lures. We have worked with different trapping methods in our vineyard. One goal of the project will be to find the best method for trapping and counting the male moths so accurate counts of the total population are available. Other results that will be obtained through the use of traps include if grape root borers have a preference for certain varieties and if the major source of adult male moths is from outside or within the vineyard. One of the main goals of the project will be to ascertain if mating disruption is possible with high numbers of pheromone traps in a vineyard thereby acting as a control measure.

Another component of the study will involve the use of plastic mulch under the vines as a method of controlling the grape root borer. A plastic mulch should trap the adults as they emerge from the ground and provide a barrier to prevent eggs from hatching into viable larvae.

3. Farm Profile

I am a part-time farmer currently farming 5 acres with my brother. The land is rented from our mother. The total size of the present farm is only 7.8 acres, although it has been cultivated by our family for seven generations. There is no house on the premises, only a 40' by 60' tobacco barn. My brother and I first planted wine grapes on the farm in 1974. Today a total of 3.5 acres is planted in producing wine grapes and includes the French hybrids: Seyval, Vidal and Chambourcin. The vines are grown with unilateral or bilateral cordon training on the bottom wire. A standard three wire system with wires at 36, 54 and 72 inches is used for the trellis. The vines are trained using vertical shoot positioning. Vineyard spacing is 9 foot wide rows with 6 feet between the vines in the row. An area of approximately one half acre is used for the growing and production of grafted vines and other varieties. Since 1989 I have also grown one half acre of saffron on the farm. Currently I am the only commercial grower of saffron in the United States.

The farm is composed entirely of Duffield silt loam with a 0 to 3% slope on the top of a

small hill. The location provides excellent air drainage with no frost pockets. The surrounding area is almost entirely in farmland and is located in an agricultural security area. There have been no changes in the farm operation since the initiation of the SARE project.

4. Participants

The technical adviser for this project is Dr. Michael Saunders of the entomology department at Pennsylvania State University. One area of his research involves the ecology and pest management of arthropods affecting vineyards and refining existing grape management practices. His extension work covers integrated pest management in viticulture. Dr. Saunders will provide expertise in the experimental design and statistical analysis of the data.

5. Project activities

In 2001 our vineyard was included in a study of grape root borer being done by a graduate student of Dr. Michael Saunders from Pennsylvania State University. For this study one white weather resistant paperboard wing trap with a pheromone lure was placed in the center of the vineyard. The trap was coated with a sticky material to capture the adult male grape root borer moths. The trap was checked twice a week or about every three or four days. It was readily apparent the trap was not totally effective. Adult male moths were observed landing in the sticky material and then flying away. Large numbers of moths were seen in the vicinity of the trap but would not enter. Additional moths were seen throughout the vineyard. During the duration of the study from June 8th to August 31st a total of 78 moths were caught in the wing trap. An additional 112 moths were captured by hand or with a net in the vineyard during the same period for a total of 190 adult male grape root borer moths.

With the failure of the paper wing trap to capture moths, I decided to use a different type of trap in 2002. Two universal moth traps constructed of plastic were purchased from Great Lakes IPM in Vestaburg, Michigan. One trap was totally green and the other had a green top, yellow midsection and a white bucket. The trap or traps with a yellow midsection will be identified as a yellow trap in this study. A 10% DDVP toxicant insecticide PVC tape measuring 1 inch by 4 inches was placed inside each trap to kill any moths that entered. The two universal moth traps were placed in the center of the vineyard about 15 feet apart from June 18th until August 31st. During that time period a total of 150 moths were captured in the yellow trap and 74 were caught in the green trap. An additional 15 were captured by hand or with a net for a total of 239 adult male moths. With the yellow universal moth trap capturing twice as many moths as the green trap a much larger sample size was needed to determine the best trap color or if the color was even important.

Also in 2002 a 100 foot section under the grape row was covered with a three foot wide piece of 1.25 mill embossed black plastic during the period when grape root borers are

active. An adjacent 100 foot section of similar vines was selected as a control. The plastic was laid on the ground on July 11th and removed October 5th. Plastic electrical conduit pipe (½ inch) was placed along the edge of the plastic to hold it in place.

A much larger sample of different colored universal moth traps was placed in the vineyard in 2003. Another variable tested in 2003 was the height placement of the traps in the row. A randomized complete block design was developed for each variable.

Three different trap colors were selected for the test, green, white and the yellow trap with green top and white bucket. The plastic universal moth traps available from Great Lakes IPM were utilized. These were the same traps used in 2002. A white trap was not available, consequently the green top and yellow midsection of the yellow traps were spray painted white. A total of 81 traps were placed in the vineyard, or 27 of each color: green, yellow and white.

The vineyard was divided into 27 blocks of 72 feet by 54 feet or 3888 square feet per block. Each block was divided into three plots of 18 feet by 72 feet or 1296 square feet per plot. A trap was suspended on the trellis at the center of each plot. Every block received the three different colors. The color of each trap placed in the plots of each block was selected using a ten thousand random digit table.

Three different trap height placements were selected for the test. Traps were placed 18 inches above the ground, or below the vine canopy, 44 inches above the ground or in the middle of the canopy close to the fruiting zone and 70 inches or at the top of the vine canopy. The distance from ground level was based on the position of the pheromone lure.

For trap height the vineyard was divided into 9 blocks of 162 feet by 72 feet or 11,664 square feet per block. Each block was divided into three plots of 72 feet by 54 feet or 3,888 square feet per plot. Each plot for the trap height experiment was the same as a block for trap color. Within each plot for trap height, the three traps received the same trap height. For each of the three trap heights there were 27 replicates, three in each plot. The height of each trap placed in the plots of each block was selected using a ten thousand random digit table.

The traps were placed in the vineyard on June 18th according to the experimental design. A 10% DDVP toxicant insecticide PVC tape measuring 1 inch by 4 inches was placed inside each trap to kill any moths that entered. A pheromone lure for grape root borer was placed in the lure holder for each trap. The traps were checked every three or four days or twice a week from June 18th until August 30th and the moths captured were recorded on data sheets.

The total vineyard area is 123,336 square feet and the experiment design covered 104,976 square feet or 85.1% of the vineyard.

Again in 2003 the same 100 foot section under the grape row was covered with a three

foot wide piece of 1.25 mill embossed black plastic during the period when grape root borers are active. The same adjacent 100 foot section of similar vines was selected as a control. The plastic was laid on the ground on July 12th and removed March 2, 2004. Plastic electrical conduit pipe (½ inch) was placed along the edge of the plastic to hold it in place.

6. Results

The first grape root borer moths were recorded on June 28th (2 moths) and the last on August 30th (1 moth). A total of 224 adult male grape root borer moths were captured. The highest number recorded was on August 2nd with 96 moths. In 2001 the highest number was recorded on July 24th (71 moths) and in 2002, July 17th (114) had the highest catch total.

Major Catch Dates for 2003

Date	Total moths captured
7-12	1
7-15	2
7-19	15
7-22	5
7-26	38
7-29	38
8-2	96
8-6	12
8-9	6
8-12	4
8-16	1

This is a typical pattern by date of moths captured.

Statistical analysis was performed on the data with two different programs. The first was the agricultural statistics analysis program (Agstats02) provided by the Pacific Northwest Conservation Tillage Systems Information Source at <http://yolo.usda-ars.orst.edu/steep/AgStatsweb/>. This program allows up to 16 treatments and 16 replications and performs an analysis of variance. The level of significance can be selected at 1%, 5%, 10% or 20%. All data entered with this program utilized the randomized complete block design option. The height treatment data in the statistical programs has been entered as low (18 inches above ground level), medium (44 inches above ground level) and high (70 inches above ground level). The color treatment data has been entered as green, yellow and white.

For an analysis of variance of the height data, three treatments (high, medium and low) were entered with their nine replications. No significant difference was found between the three treatments even at a 20% level of significance.

The experimental design for each color treatment (green, yellow and white) contained 27 replicates. Unfortunately the Agstats02 program allows only 16 replicates. To run this program the three replicates of each color in each height block were combined. The three treatments (green, yellow and white) were entered with nine replications. At a 5% level of significance, the green and yellow traps were significantly more effective than the white traps.

LSD (least significant difference) 5

treatment name	mean		
treatment 3 white	4	A	treatments with different letters are significantly different
treatment 1 green	10	B	
treatment 2 yellow	11	B	

An analysis of variance for the combined treatments (height and color) was performed. For this statistical analysis nine treatments were entered with nine replications. Within each height treatment block (162 ft. by 72 ft.) there are all nine possible combinations of height and color treatments such as high green, medium yellow and low white. At a 5% level of significance, there was no significant difference among the nine treatments. At a 10% level of significance the medium yellow, high yellow and high green were significantly more effective than the low white and medium white. This result is to be expected because the green and yellow traps, based on color alone, were significantly more effective.

LSD (least significant difference) 3

treatment name	mean		
low white	1	A	treatments with different letters are significantly different
medium white	1	A	
high white	2	AB	
low yellow	2	AB	
low green	3	AB	
medium green	3	AB	
high yellow	4	B	
high green	4	B	
medium yellow	5	B	

Three varieties of French hybrid grapes; Seyval, Vidal and Chambourcin are planted in the vineyard. The experimental design was developed primarily to test if adult male grape root borer moths would have a preference for different pheromone traps based on color and location. The initial plan called for an attempt to determine if grape root borers have a preference among the three varieties planted in our vineyard. Unfortunately the experimental design only allows a comparison to be made between Seyval and Vidal.

For an analysis of variance based on variety preference, two treatments (Seyval and

Vidal) were entered with eight replications. No significant difference was found between the two varieties even at a 20% level of significance.

The other statistical program utilized was SAS/STAT performing an analysis of variance and Tukey's studentized range (hsd) test. This test is also called the *honestly significant difference* (hsd) procedure. Utilizing this test on the three height treatments (high, medium and low) with 27 replicates each, no significant difference was found between the treatments at a 5% level of significance.

When the Tukey's studentized range test was used on the three color treatments (green, yellow and white) with 27 replicates each, a significant difference was found. At a 5% level of significance the yellow traps were more effective than the white.

LSD (least significant difference) 2.0991

treatment name	mean		
yellow	3.7407	A	treatments with different letters are significantly different
green	3.2593	AB	
white	1.2963	B	

The statistical analysis of the catch data shows the three height placements have no effect. It also reveals the color of the trap is important. The yellow and green traps were statistically more effective than the white traps.

No data was collected from the plastic mulch cover experiment. The technical adviser for the project, Dr. Michael Saunders had a serious injury in October of 2003 and was unable to survey the site for the pupal cases of grape root borer. Dr. Saunders was the only person who had the expertise to identify pupal cases of grape root borer.

7. Conditions

N/A

8. Economics

N/A

9. Assessment

The first year (2001) a trap was placed in our vineyard, one white paperboard wing trap was used. Large numbers of moths were seen in the vicinity of the trap that would not enter. The current study (2003) would indicate the white color inhibits capturing the maximum number of grape root borer moths. Less expensive white wing traps should not be used if the target insect is grape root borer. A universal moth trap of green or yellow color should be used.

Additional years of data collection will be necessary to validate the results from 2003. A total of 81 traps were placed in a 3.5 acre vineyard, capturing a total of 224 moths. Of those 81 traps, 25 traps or 31% caught no root borers at all. Four traps, or 5% were responsible for 25% of the moths captured. Even in a small vineyard it would appear there are areas of high concentrations of grape root borers. The study will have to continue to determine if the root borers are localized within small areas of the vineyard. If the study is repeated using the same plots and blocks with the traps placed in a new random selection, areas with high concentrations of root borers should be apparent.

More years of research will be required to determine if a high number of traps can result in mating disruption. The two year life cycle of grape root borer larvae means a longer period of research is needed.

10. Adoption

Although no data was collected from the plastic mulch experiment, the process is not feasible for the control of grape root borer from an economical standpoint. The time required to properly place, tape and anchor the plastic is prohibitive. After two years of applying a small area of plastic mulch in the vineyard this procedure will be discontinued.

The results from the research in 2003 would indicate a green or yellow trap should be used to maximize the number of grape root borers captured. Varying the position of the traps within the trellis does not influence the capture rate of the moths. The procedure will be repeated in 2004 to verify the findings. In subsequent years the best trapping method found by our research will be used to maximize captures and determine if mating disruption is possible.

11. Outreach

A thirty minute presentation on the research findings from 2003 will be presented April 27, 2004 at the Pennsylvania Wine Association annual meeting in Altoona. Additional outreach will soon be completed through the preparation of a one page synopsis of the research findings to date. The review will be disseminated by Mark Chien, the wine grape agent for the Penn State University Cooperative Extension. This review will be distributed through Mark's e-mail newsletter, grape information for Pennsylvania and the region, reaching 350 grape growers. It will also be published in Mark's hard copy quarterly newsletter, The Grapevine, with a circulation of 800 grape growers. Plans are now being formulated to make a presentation at the 2005 Mid-Atlantic Fruit and Vegetable Convention in Hershey, Pennsylvania on the research findings from 2003 and 2004.

R. Martin Keen