Washington State Grape and Wine Research Program

DUE June 30, 2019
by email to: ARCGrants@wsu.edu

PROJECT TITLE: QUANTIFYING GRAPE MEALYBUG'S EFFICIENCY AS A VECTOR OF GRAPEVINE LEAF ROLL ASSOCIATED VIRUSES (GVLRAVS).

Project Duration: ***(List Years)*** 3
WRAC Project No.

PI Name:	**DOUG WALSH**
Organization	WSU IAREC ENTOMOLOGY
Address	24106 N BUNN RD PROSSER, WA 99350
Telephone	509-786-9287
Email	DWALSH@WSU.EDU

CO-PI Name:	**NAIDU RAYAPATI**	**CO-PI Name:**	
Organization	WSU IAREC PLANT PATHOLOGY	Organization	
Address	24106 N BUNN RD PROSSER, WA 99350	Address	
Telephone	509-786-9215	Telephone	
Email	NAIDU.RAYAPATI@WSU.EDU	Email	
CO-PI Name:	**JONATHAN O'HEARN**	**CO-PI Name:**	
Organization	WSU ENTOMOLOGY	Organization	
Address	24106 N BUNN RD PROSSER, WA 99350	Address	
Telephone	509-786-9244	Telephone	
Email	JONATHAN.OHEARN@WSU.EDU	Email	

Cooperator Name:		**Cooperator Name:**	
Organization		Organization	
Description of participation:		Description of participation:	

BUDGET AND OTHER FUNDING SOURCES

FINAL FINANCIAL REPORTING

BUDGET *(LIST COMPLETED BUDGET NUMBERS)*

	Year 1 FY	**Year 2 FY**	**Year 3 FY**
	Jul 17 – Jun 18	Jul 18 – Jun 19	Jul 19-Jun 20
Total	$19,746	$20,392	$21,302
Footnotes: A total of $61,440 has been provided for this project			

Total Project Funding: $61,440

Project Budget Status: *Although this is a "final report" we still have grapevines that have been exposed to infected mealybug crawlers that we will continue to monitor for successful transmission of Grape Vine Leaf Roll Associated Virus #3.*

Project Summary:

Grape mealybugs (*Pseudococcus maritimus*) have been identified as the primary vector of grapevine leafroll associated viruses (GLRaVs) in Washington vineyards. While it is known that the grape mealybug is the vector of GLRaVs their efficiency as a vector had not been determined. Is feeding by a single infected mealybug crawler enough to vector the virus? Or does it take some cohort of mealybug crawlers feeding to transmit the virus? Current mealybug control measures use systemic insecticides that require some period of feeding before the insecticide will inhibit the mealybugs from feeding or cause mortality. It is unknown if the time lag between the initiation of feeding by mealybugs and the cessation of feeding by the mealybug crawlers as a result of exposure to systemic insecticides would allow for the transfer of the viruses. Knowing the grape mealybug's vector efficiency and the effectiveness of current chemical controls should help growers build better future Integrated Pest Management (IPM) programs to control the spread of GLRaVs.

To determine if a low cohort of mealybugs were capable of transferring the virus, GVLRaV infected mealybugs were placed on clean potted grapevines. On 20 potted grapevines per treatment, 1 and 5 infected mealybug crawlers were placed on each grapevine and allowed feed and persist for as long as they could. The potted grapevines were allowed to sit for one year for the titer of virus to build in the vines. The vines were then tested using PCR analysis to determine the percentage of grapevines that became infected. To test the current systemic insecticides effectiveness in preventing the spread of the virus 40 potted grapevines per insecticidal treatment were treated with the insecticides imidacloprid, spirotetramat (Movento™), and flupyridifuron (Sivanto™). In each insecticidal treatment, 20 grapevines were treated with the high field rate and the other 20 with the low field rate. On each grapevine 10 GVLRaV infected crawlers were transferred from infected grapevines, and allowed feed and persist for as long as they could. The grapevines were then allowed to sit for one year to allow for the titer of virus to build in the vines, which will be July 2019. PCR analysis will be used to

determine the percentage of grapevines that became infected as compared to control plants not treated with insecticide.

Our ultimate goal of these experiments was to increase our knowledge of the epidemiology of GLRaVs and its grape mealybug vector to help growers improve their future IPM programs. Our first experiment allowed us to produce the number of mealybugs required to achieve this. Our second experiment's goal was to determine the number of mealybugs required to transfer the virus. And our last goal was to determine if current management practices are effective in slowing the spread of GLRaVs in vineyards and possibly reduce unnecessary insecticide applications.

Project Major Accomplishments:

Rearing colonies of grape mealybugs has been difficult for researchers. A large number of mealybug crawlers were required for this experiment. We tested several candidate plants to see if any would be useful. We successfully created a mealybug rearing protocol on pumpkins. To our knowledge, this is the first time grape mealybugs have ever been reared on pumpkin. This protocol has been published in Journal of Economic Entomology and can now be used by other researchers in creating laboratory colonies of grape mealybugs

One of the problems with GLRaVs studies is that there is up to a year lag from when the virus was transferred to when it can become detectible in the vine. Our study using 1 and 5 mealybugs per vine found some positive results after year one, but the PCR banding was extremely weak. This is probably because the amount of virus transferred was low and a large titer of GLRaVs had not yet built in the vine. The vines were allowed to sit for another year to build a larger titer. Samples of these vines were sent to The Clean Plant Center Northwest (CPCNW) to have an outside party confirm our results. The samples are currently in queue and results should be received soon.

Our initial testing of vines that had the 5 mealybugs treatment showed that 5 out of the 20 vines tested positive for GLRaV-3. In the 1 mealybug per vine treatment 2 out of the 20 vines tested positive for GLRaV-3. This shows that even at very low numbers mealybug crawlers are still capable in spreading the viruses. These numbers were achieved in laboratory and greenhouse conditions. A lower transfer rate in vineyards is probable due to many other factors the mealybugs would be exposed to in the field. However, given that transfer is possible at such low numbers mealybug populations must be kept to a minimum in vineyards to help prevent the spread of GLRaVs. Unfortunately, this makes the treatment threshold for grape mealybug effectively zero. This does not bode well for future IPM programs in Washington State vineyards.

Our experiment to test whether current insecticidal controls are capable of preventing the spread of GLRaVs is still currently awaiting the one-year mark for testing, which is coming up in July. Samples from these vines will be sent to CPCNW and results will be obtained by the end of July. Information obtained from this study will show growers how effective these insecticides are at slowing the spread of GLRaVs. Mealybug(s) on some of the imidacloprid treated vines were still

present over one month after treatment (Jonathan O'Hearn personal observation). Since imidacloprid is the major insecticide used, it will be useful for growers to see if it is effective on preventing GLRaVs spread. Results from the other systemic tested will help growers determine if those might be effective treatments to implement if imidacloprid is shown not to be effective. Information from both studies will be sent to scientific publications and given at trade talks to disseminate this information.

Information Dissemination, Extension, and Outreach Activities:

Pumpkin as an Alternate Host Plant for Laboratory Colonies of Grape Mealybug (2018) Journal of Economic Entomology 111(2): 993-995

Literature Cited:

Bahder, B.W., S. Poojari, O. J. Alabi, R. A. Naidu, & D. B. Walsh. 2013. *Pseudococcus maritimus* (Hemiptera: Pseudococcidae) and *Parthenolecanium corni* (Hemiptera: Coccidae) are capable of transmitting Grapevine leafroll-associated virus 3 between *Vitis labruscana* and *Vitis vinifera*. Env. Entomol. http://dx.doi.org/10.1603/EN13060

Rayapati, N., S. O'Neal, & D. Walsh. 2008. First Report of *Grapevine leafroll associated virus-3* in American *Vitis* spp. Grapevines in Washington State. Plant Disease. 90:1461 http://dx.doi.org/10.1094/PD-90-1461A

Soule M.J., SK.C. Eastwell, & R.A. Naidu. 2008. Grapevine leafroll disease. WSU Extension Bulletin EB2027E

Walsh, D.B., S.D. O'Neal, A.E. George, D.P. Groenendale, R.E. Henderson, G.M. Groenendale, & M.J. Hengel. Evaluation of Pesticide Residues from Conventional, Organic, and Non-treated Hops on Conventionally Hopped, Late-Hopped and Wet-Hopped Beers. Journal of the Association of Brewing Chemists.

Extension Presentations

February 14, 2019	Mealybugs, Leafrollers and Grape Flea Beetles. Washington Wine Growers Association. Kennewick, WA.
January 17, 2019	Monitoring Mealybugs for Potential Imidicloprid Resistance and Buffalo Treehoppers for Imidicloprid Susceptibility. Washington Wine Commission. Prosser, WA
November 9, 2018	Red Blotch Vectors. Washington Grape Society. Grandview, WA
August 7, 2018	Monitoring mealybugs for potential Imidacloprid resistance. Washington State Wine Grape Research Program. Prosser, WA presented by Sally O'Neal
April 4, 2018	Potential for Red Blotch Disease in Washington. Washington Advances in Viticulture and Enology. Prosser, WA

March 15, 2018	Managing Vectors of Grapevine Leafroll Disease. Washington Advancements in Viticulture and Enology, Richland, WA
November 17, 2017	Insect and Mite Management. Washington Grape Society. Grandview, WA
May 2, 2017	No Rain, Cold Winter: the Terroir of successful IPM in Washington State Vineyards. Washington Advancements in Viticulture and Enology
April 19, 2017	Investigation of Vectors of Grapevine Red Blotch Associated Viruses in California and Oregon & Plans for Washington State. Washington Advancements in Viticulture and Enology.
November 10, 2016	Grape Pest Update. Washington Grape Society. Grandview, WA
July 14, 2016	Pest Management: Successes & New Challenges. Washington Advancements in Viticulture and Enology. WSU-Tri-Cities