



VA vineyards Grape Leafroll Disease Survey

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● ● ● | Grape Leafroll Disease

- Caused by a group of virus called Grape Leafroll-associated Viruses (GLRaVs)
- > 10 different viruses are found to cause similar disease symptoms
- Disease symptoms
 - red, curled leaves,
 - poor sugar accumulation,
 - loss of vine vigor, etc.





Objectives

1. Document the prevalence and spatio-temporal pattern of grapevine leafroll disease and associated viruses in Virginia
2. Determine whether native *Vitis* species serve as asymptomatic hosts
3. Develop observational data as to the presence of mealybugs as a potential vector.
4. Determine the movement of GLRaVs from infected vines to newly planted clean vine within the same row, and examine a potential management tool to restrict the movement of the vector.



In 2009, over 500 samples were taken from a total of 45 vineyards and 8 wild grape vines.

Table 1. Summary of viruses detected from sampled vines, Virginia 2009

Numbers represent (observed)/(sampled) count of GLRaV-2, -3, and GfkV (Grapevine fleck virus)

Region	Variety	GLRaV-2	GLRaV-3	GfkV
Central	Cabernet franc	0/1	1/1	0/1
	Cabernet sauvignon	0/5	4/5	0/5
	Chamboucin	0/1	0/1	0/1
	Chardonnay	0/2	1/2	0/2
	Gewurztraminer	0/1	1/1	0/1
	Merlot	0/2	2/2	0/2
	Pinot Gris	0/1	1/1	0/1
	Riesling	0/1	1/1	0/1
	<i>Vitis riparia</i>	0/2	0/2	0/2
Eastern	Cabernet franc	1/1	1/1	0/1
	Cabernet sauvignon	1/2	1/2	0/2
	Chardonnay	0/1	1/1	1/1
	Shiraz	0/1	0/1	0/1
	<i>Vitis riparia</i>	0/1	0/1	0/1
Northern Piedmont	Cabernet sauvignon	1/5	3/5	0/5
	Chamboucin	0/1	0/1	0/1
	Chardonnay	2/4	3/4	0/4
	Malvec	0/2	0/2	0/2
	Merlot	0/8	1/8	0/8
	Petit Manseng	0/1	0/1	0/1
	<i>Vitis riparia</i>	0/3	0/3	0/3
<i>Vitis rotundifolia</i> (Muscadine)	0/1	0/1	0/1	
Southern Piedmont	<i>Vitis rotundifolia</i> (Muscadine)	0/1	0/1	0/1
Southwest	Cabernet franc	1/2	0/2	0/2
	Cabernet sauvignon	0/1	0/1	0/1
	Sangiovesse	1/1	1/1	0/1
	Vigonier	0/1	1/1	0/1



Petiole samples are taken from suspected vines, then sent to WSU

- Dr. Naidu Rayapati at Washington State University at Prosser helped to identify viruses using molecular genetics techniques

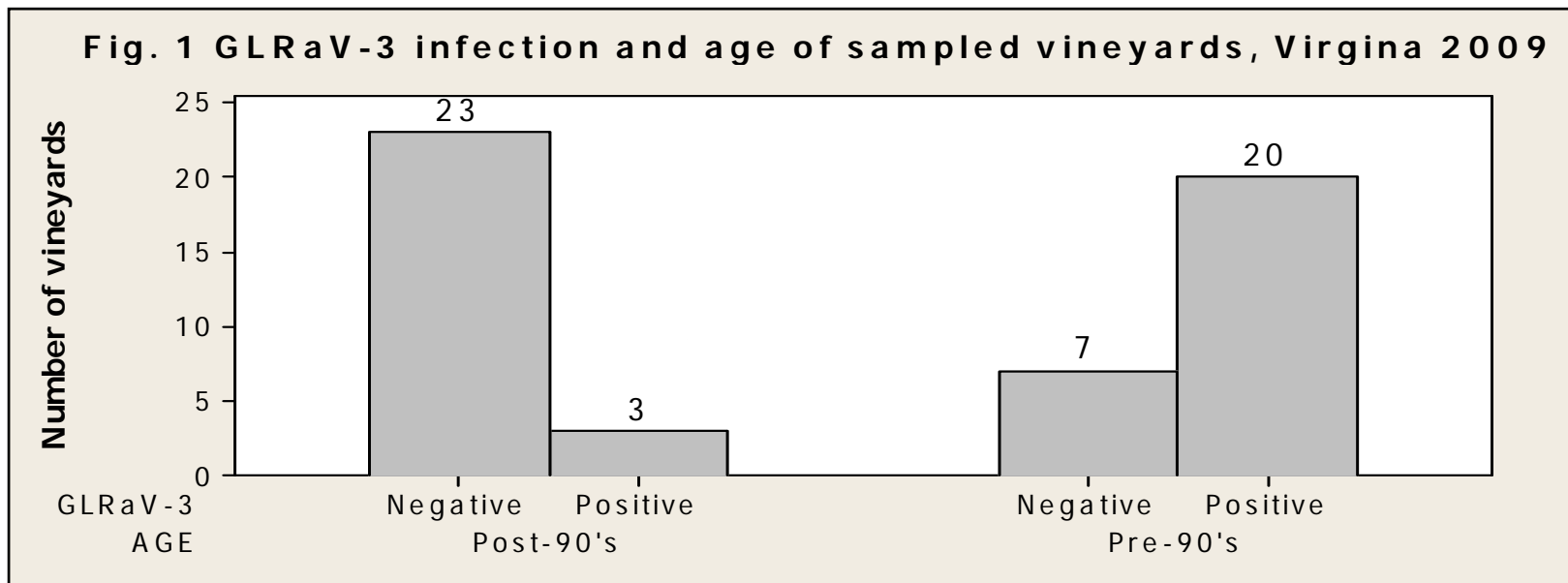


Objective 1: Survey



51% of surveyed vineyards are positive of either GLRaV-2 or -3

- Majority of vines that were positive with GLRaV-2 or 3 were either planted in 80's or earlier when the virus indexing program was not placed among nurseries
 - or it may be planted later, but vines from the pre-virus indexing period were present in a close proximity in some time of the vineyard history.



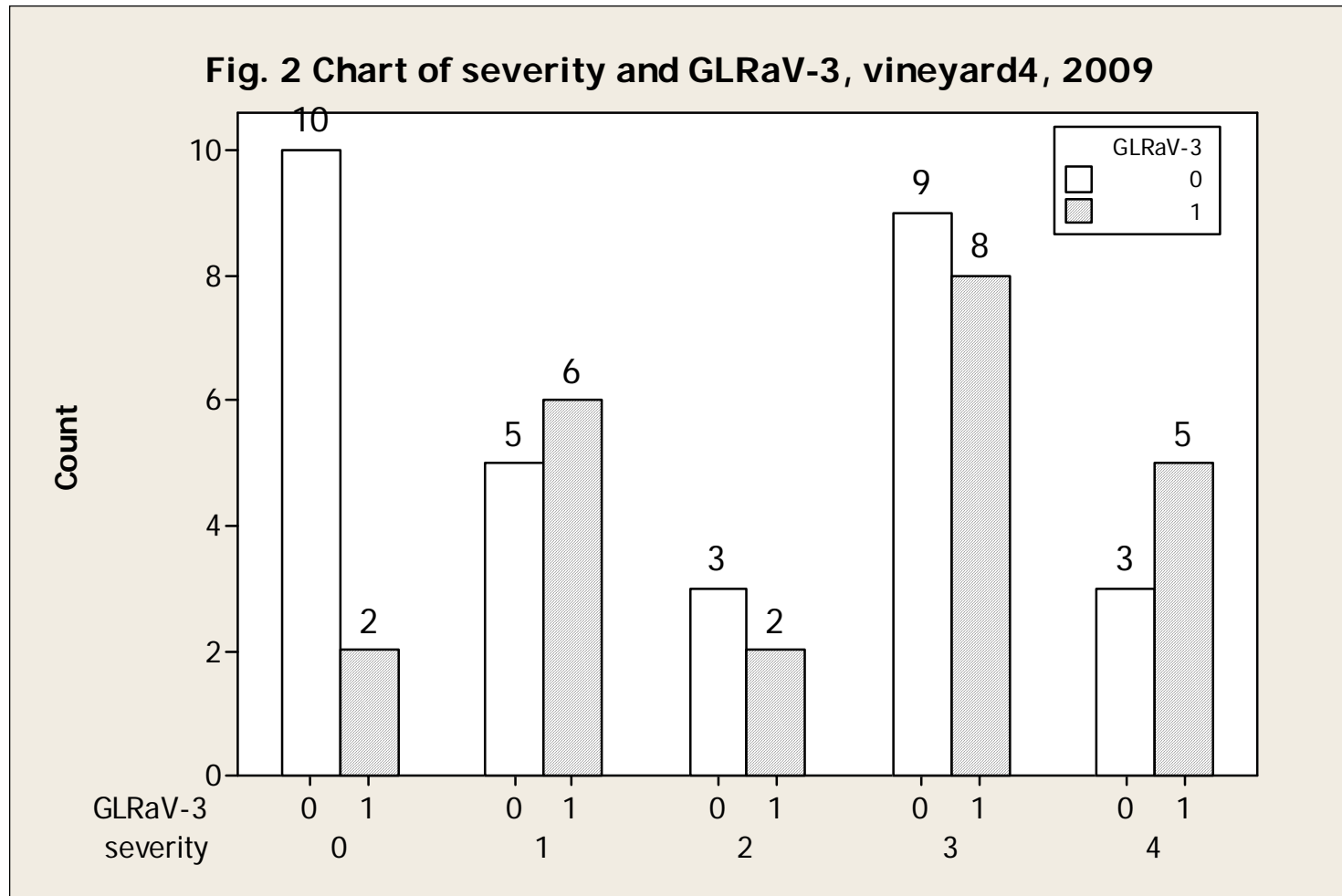


Objective 1: Survey

- Disease intensity was not a good indicator for the actual infection. (more on this issue tomorrow)
 - Without elaborate molecular tools, it is very difficult to determine the seemingly infected vines are indeed infected.
 - Important to know whether GLRaVs are the cause of the symptoms because vines may need to be removed



The vine may have the virus without visual symptoms, and also, vines with typical symptoms (red and curled leaves) may not turn out be positive.



Objective 2: Wild grape vines



All 8 vines tested were found to be negative of GLRaVs

- The relative distance to infected vineyards did not matter.
- *V. riparia* and *V. rotundifolia* (Muscadine) were commonly found in VA,
- This is a very encouraging finding; however, since the sample size is small, there are needs for more sampling in 2010 season.
- Depends on the results, importance of site selection may need to be emphasized, and through removal of wild vine nearby vineyard may be recommended.

Objective 3: Mealybugs

- ● ● Several vineyards were identified with a presence of mealybugs in 2009
- + Infection on younger vines indicated transmission of the viruses from older vines to newer ones
- Identification of the species needs to be done by a specialist because the appearance (the shell of a mealybug) is fragile and very difficult to key the characteristics.



Objective 3: Mealybugs

- ● ● The identification will be conducted in 2010 season with a help of Dr. Greg Hodges of FDACS-DPI.
- It is very important because the rate and efficiency of transmission may depend on the species of mealybugs.



● ● ● | Objective 4) Transmission and management

- A field trial has been conducted to see the efficacy of insecticide application
- Vines are inter-planted in an infected vineyard at Winchester AREC
- Two application timings:
 - Assile at pre-bud break
 - Baythroid at bloom
- Three treatments
 1. Both pre-bud break and bloom
 2. Only at pre-bud break
 3. No insecticide





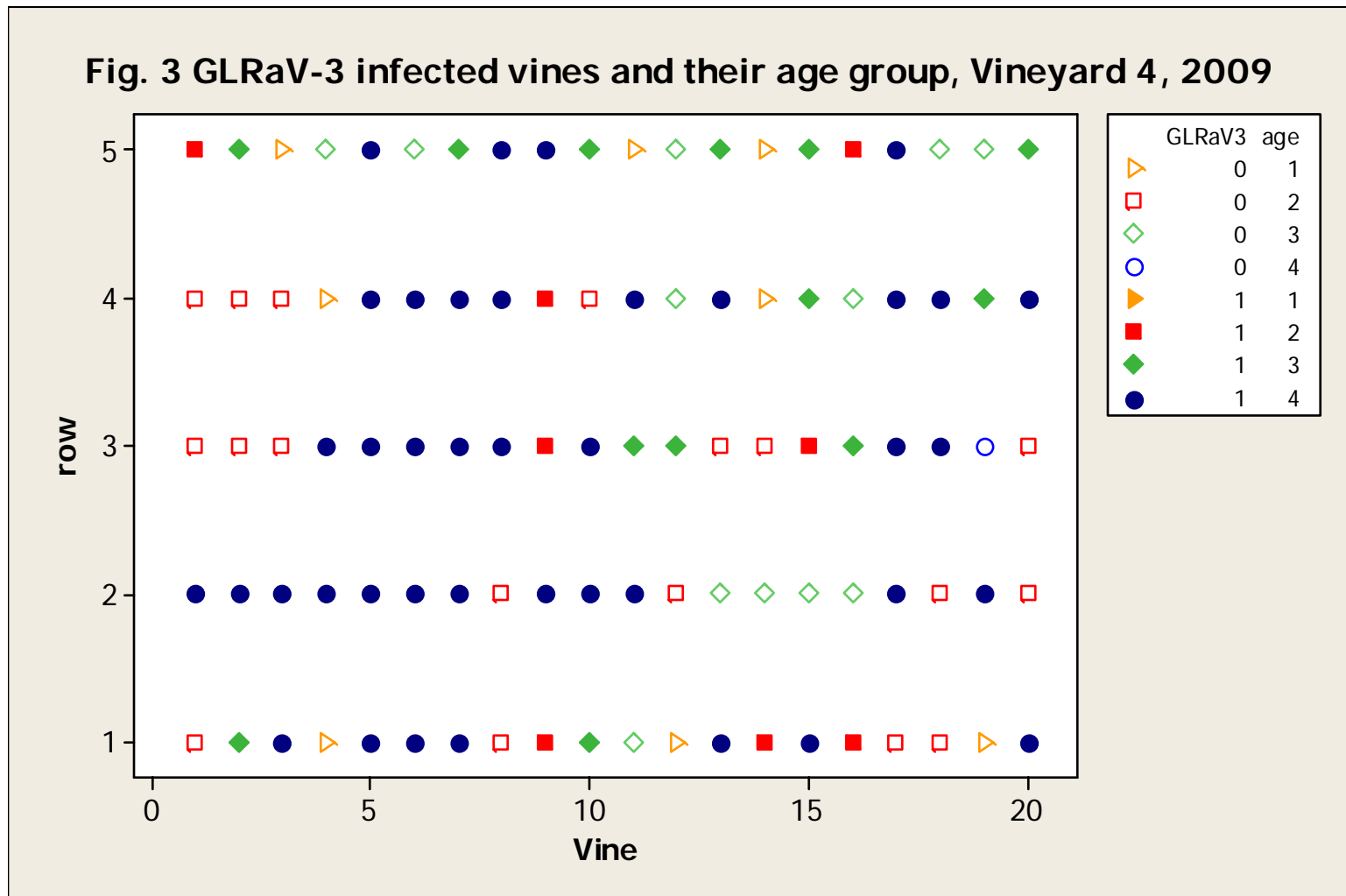
Objective 4: Transmission and Management

- Among new vines, one of them (treatment 3: no insecticide) were identified positive with GLRaV-3, indicating the spread via mealybugs, although there were no visual symptoms.
- No mealybugs were observed with visual assessment of vines; however, exoskeleton of the insect has been observed in the vineyard.
- Results indicated that spread of the virus can occur within the first year of planting if infected vines exist nearby, and the infected young vine may not show visual symptoms.
- The experiment will be continued in 2010 to examine the consistency of the efficacy of the insecticide.



Objective 4: Transmission

A vineyard with inter-planted vines showed the evidence of transmission





New Items and Adjustments for 2010

- The procedures will be repeated with some changes:
 1. Samples will be tested for more GLRaVs (1, 2, 3, 4, 5, and 9), and for other viruses: grapevine fleck virus (GvFks); Grapevine virus A and B (GVA and GVB); and Rupestris stem pitting virus (RSPaV) in 2010;
 2. Samples that do not require multiple virus testing will be processed at Winchester AREC, instead of sending samples to Dr. Rayapati's lab (which allows us to establish a basic molecular-based lab which we do not currently have);
 3. More wild grape samples will be taken; and
 4. Mealybugs will be identified.
- **Objective 5)** Determine the association of viruses within a vine (mixed infection) and its potential effects.

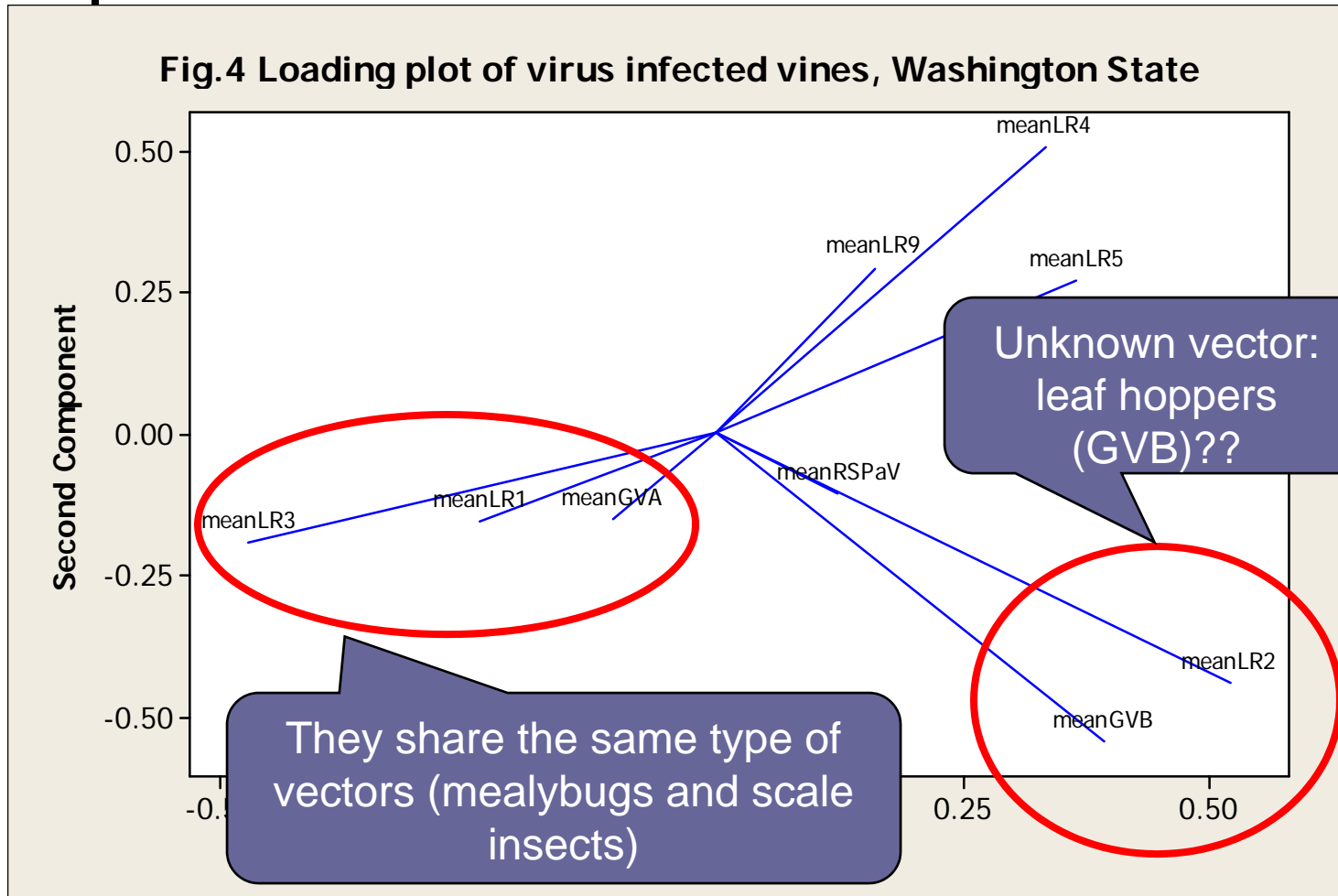


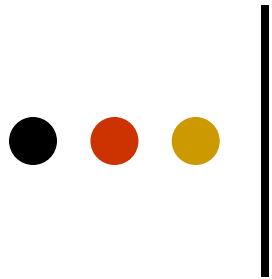
Objective 5) Determine the association of viruses within a vine (mixed infection) and its potential effects.

- Existing dataset of virus assay (>1600 samples) that were collected through 2001-2009 in Washington State were examined in 2009. Screenings of GLRaVs (1, 2, 3, 4, 5, and 9), GvFks, GVA, GVB, and RSPaV were done for these samples.
- Associations of viruses were examined using various statistical methods such as the Jaccard association index and the multivariate analyses.
 - Examination of the Jaccard index showed that some of viruses, such as GLRaV-2 and -4, are associated (tended to be infect the same vine at the same time) and others, such as GLRaV-1 and -2, are disassociated (less likely to be present in the same vine at the same time).



Other statistical procedure showed a potential grouping of viruses by vector





The impact

- This project is a multi-state collaboration between VA and WA
- A free virus detection service which could cost more than \$300 per sample via commercial labs.
 - A discussion on grape disease management beyond the scope of the survey.
- Results from the field transmission study will give us a tool to manage infected vineyards, which are commonly found in other grape growing regions such as NY, WA, and CA.
- Information on the mixed infection of viruses, i.e., which viruses tend to infect a grapevine together, can be used to set a guideline for the virus screening for the clean plant material production.
- If the mixed infection results in synergistic relationships among viruses, the finding will help growers to determine whether GLRaV infected vines are needed to be removed.

- ● ● | 2010: More samples needed

- We will continue on the survey to have clear picture on the extent of GLRaV infection throughout VA vineyards
- Please contact me by phone or email
- I will take samples and it won't take much of your time!

