



# **UC Cooperative Extension Update: Foothill Wine Grape Research Projects**



**Lynn Wunderlich**  
**UC Cooperative Extension Farm Advisor**  
**El Dorado and Amador Counties**

***Foothill Grape Day 6/9/11***

# Thanks to:

- Amador Wine Grape Growers Association
- Betsy Tsumbas, Beth Rosenthal,  
Pat Rohan
- Amador Fairgrounds
- Donating Wineries
- *All* of our speakers
- Robin Cleveland ★

Packets: Please fill out the gold comment postcard and return to me!!

EGVM posters available to post in your farmshed.



# What's happening with the WEATHER?

National Weather Service “daily observer” site near Camino  
May 15, 2011



Max: 56°

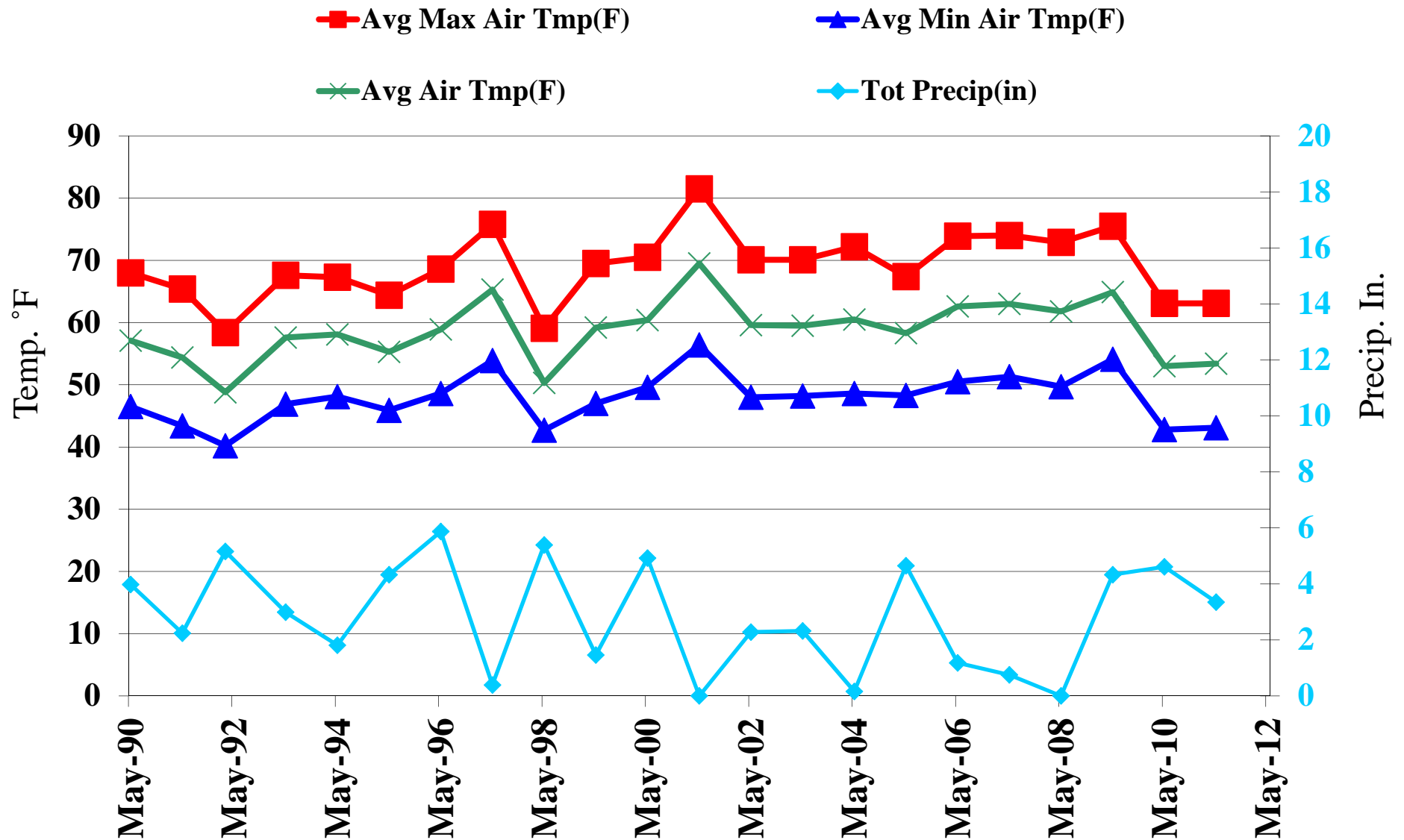
Min: 32°

Observ: 35°

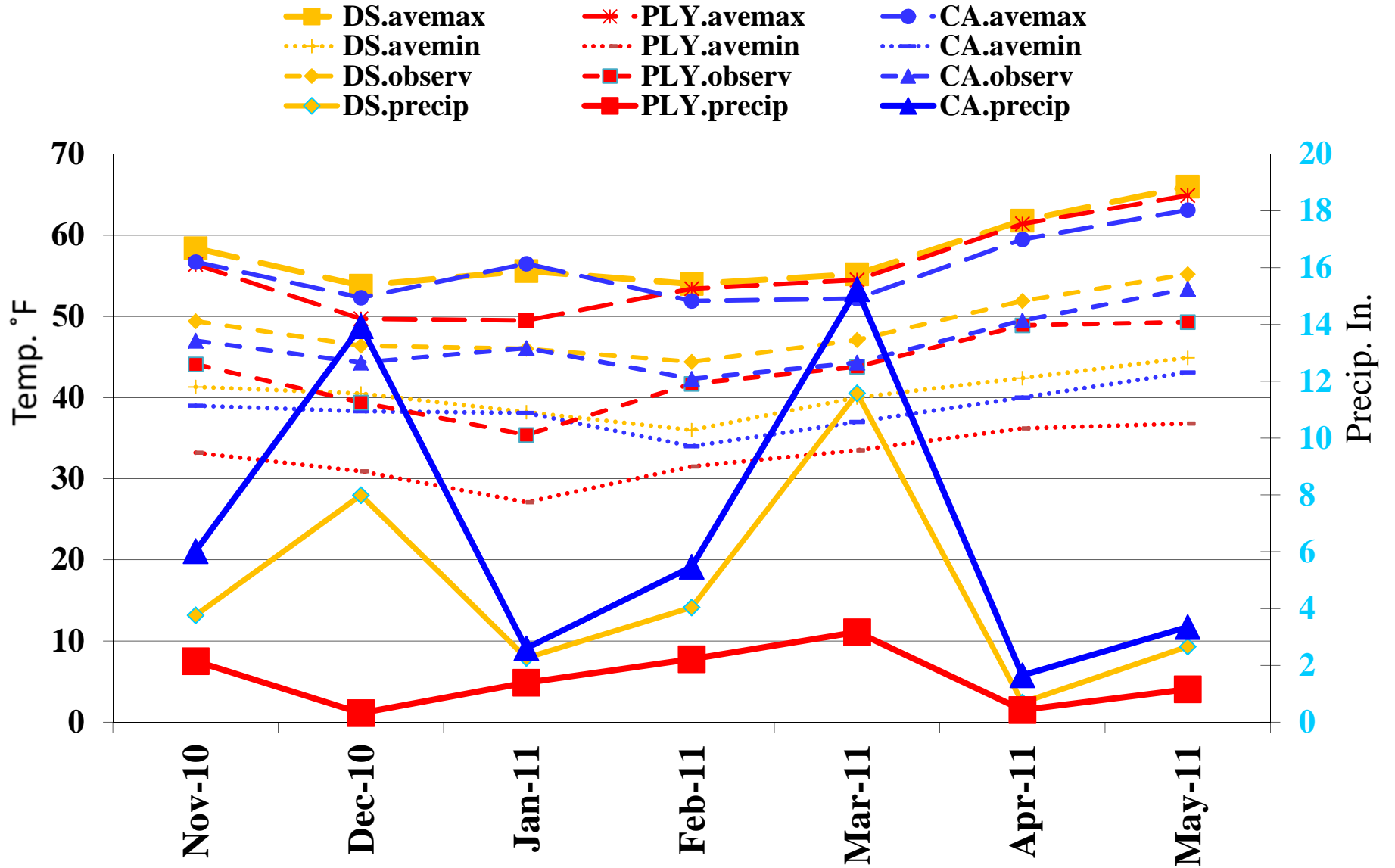
3.5 in. snow

# Average Max Air Temp, Average Min Air Temp, Average Air Temp (all °F) and Total Precipitation (in.) for the month of May 1990-2011.

*Camino CIMIS station data.*



## Comparison of foothill CIMIS stations, Diamond Springs (DS), Plymouth (PLY) and Camino (CA): Monthly average max, min, and average air temperature and total precipitation, Nov 2010-May 2011.



## Comparison of CIMIS stations: Diamond Springs, Plymouth and Camino, Precip. Nov 2010-present

Month	Diamond Springs precip	Plymouth precip	Camino precip
Nov-10	3.76	2.15	6.02
Dec-10	7.99	0.32	13.94
Jan-11	2.26	1.39	2.6
Feb-11	4.04	2.22	5.47
Mar-11	11.58	3.17	15.24
Apr-11	0.69	0.43	1.65
May-11	2.66	1.16	3.35
<b>sum</b>	<b>32.98</b>	<b>10.84</b>	<b>48.27</b>



# UCCE Foothill Grape Research Project Summary

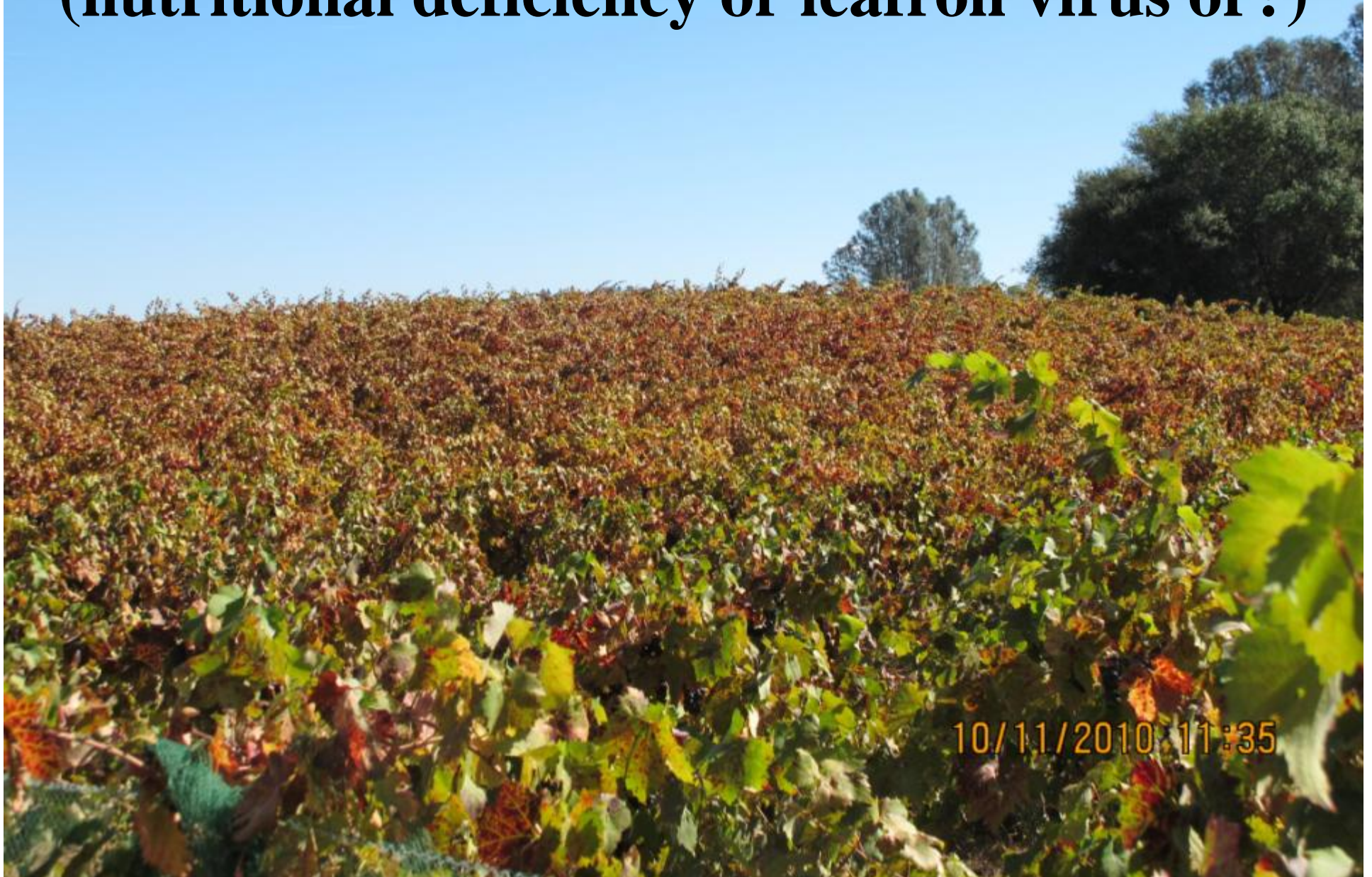
**Recurrent theme: What's causing the "Red Leaf" phenomenon? *Increasing our knowledge over time***

- **Nutritional deficiencies: can we mitigate symptoms and show petiole uptake with fertilizing?**
  - Understanding foothill soils and potential for nutrient management recommendations based on soil type
- **Leafroll virus: which species are present here?**
  - Mealybugs and other potential leafroll vectors  
**Phylloxera?**
  - Gill's mealybug biology and management

New collaboration: Pierce's Disease cold curing study

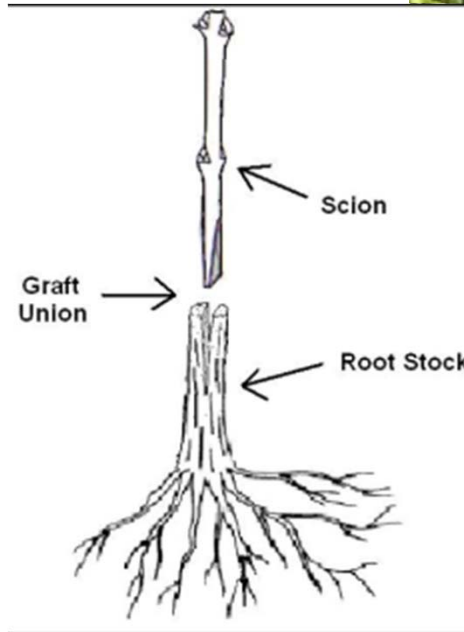


**Case study: What's causing the red leaf?  
(nutritional deficiency or leafroll virus or?)**



# Background: Grapevine leafroll associated virus (GLRaV)

- Transmitted by planting or grafting infected material and by mealybugs or scale  
(vector-lr species specific).
- Symptoms appear in fall as “red leaf”; reduced yield, poor color, and sometimes trouble with Brix, ripening.
- Currently 9 distinct virus species GLRaV-1 to GLRaV-9
- Detection methods continue to improve-vary in accuracy to pick up virus.



# Leafroll and other viruses can cause “red leaf” symptoms

What symptoms you see depends on:

- Time of year
- Rootstock, scion and the interaction
- Stress of the vine (drought conditions, other pest issues, etc.)

“worse some years than others”

- Nutritional status.
- Viruses are unevenly distributed
  - In the vine
  - In the vineyard
- Some viruses can be present but asymptomatic
- Not much known about a lot of other viruses-  
>50 viruses known in grape.



# Nutrient deficiencies can look similar and confuse the picture



**Potassium deficiency**

**Cab Franc**

Pete Christensen

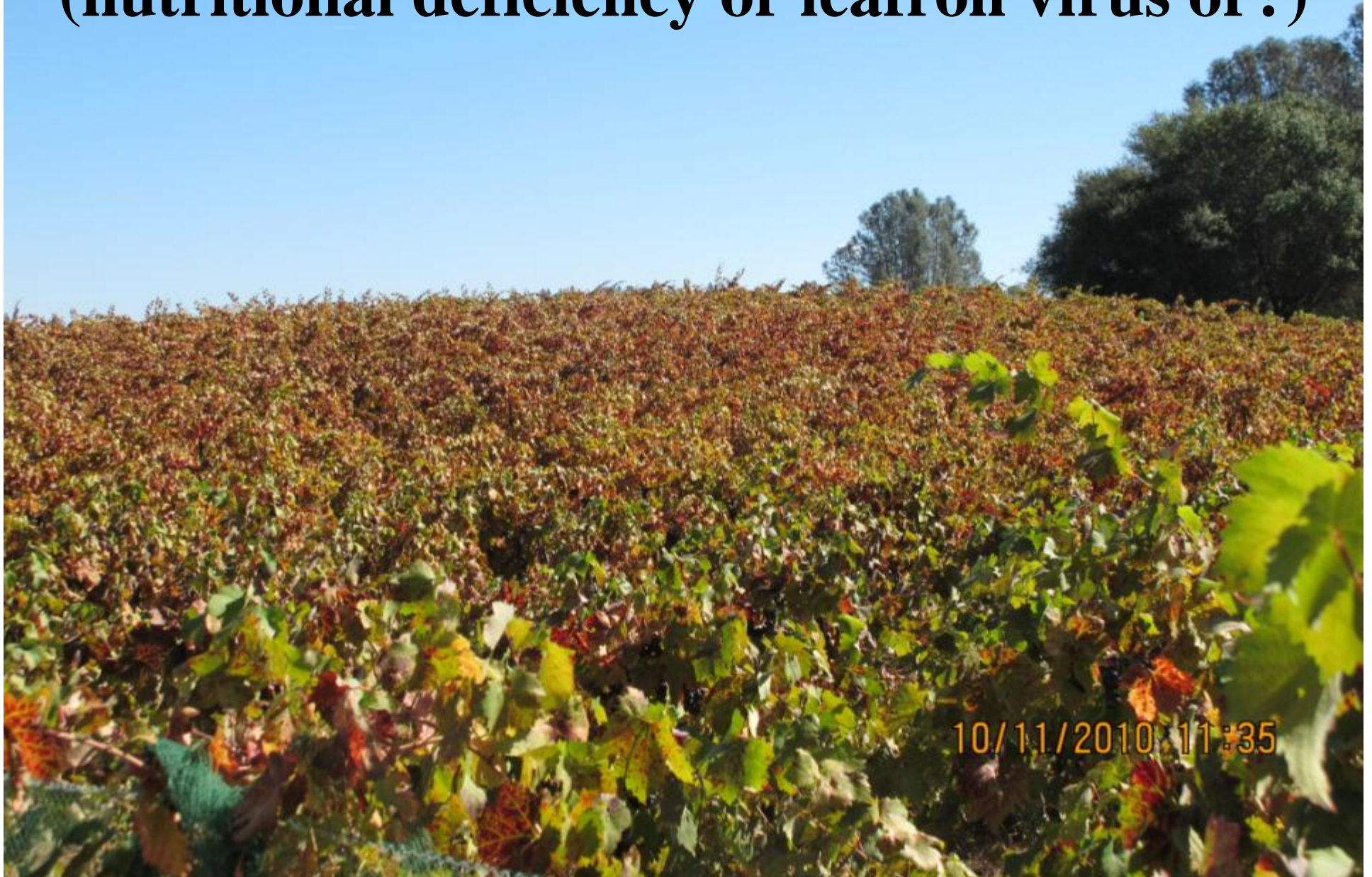


**Boron deficiency**



**Phosphorous deficiency Cab. Sauvignon P. Christensen**

**Case study: What's causing the red leaf?  
(nutritional deficiency or leafroll virus or?)**



# “Red Leaf” case study

- Located in SE El Dorado County
- Boomer-Sites soils series -tend to be P deficient
- Two blocks, Primitivo on St. George and Barbera on 1103P, St. George, 110R
- Planted in 2002, “Red leaf” showing up beginning in 2007 across both varieties
- Several Barbera clones, some certified scions; rootstocks not certified
- Petiole history inconsistent
- LR virus tested by Golino lab using PCR (Oct. 2009): 3 samples, one + for GLRaV-5

Date sampled	Variety	Total % P	Total % K
5/28/2009	Barbera	0.54	3.13
5/27/2008	Barbera	0.34	1.86
6/11/2006	Barbera	0.39	1.44
5/28/2009	Primitivo	0.76	4.4
5/27/2008	Primitivo	0.21	1.1
6/11/2006	Primitivo	0.18	1.07

Christensen threshold for P is 0.15-0.20 (DellaValle 0.2-0.5)

For K is 1.5 (DellaValle 2-3)

Barbera positive for  
GLRaV-5



Negative Barbera



Negative Primitivo



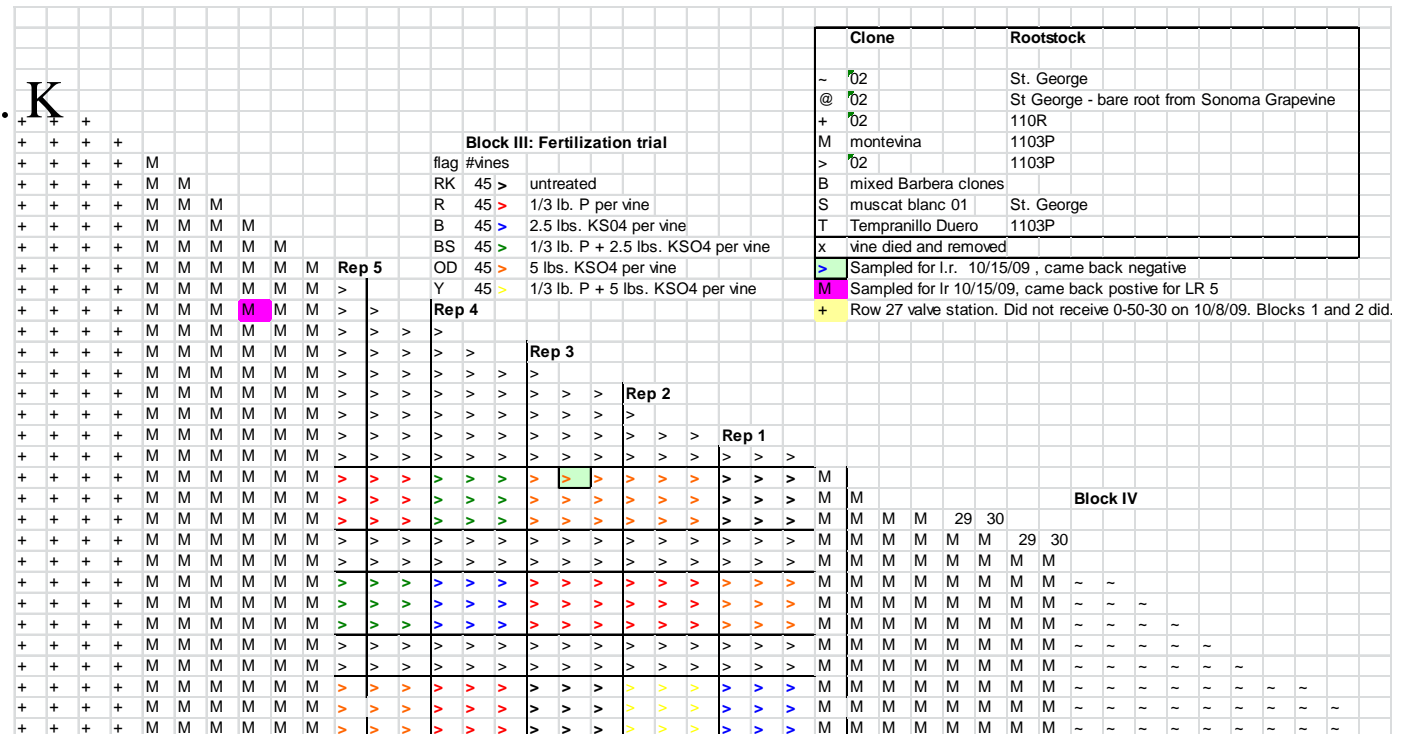
# P &K fertilizer trial: Can we mitigate red leaf and/or see uptake in petioles?

5 replicates, 9 vines/plot, sampled middle

Babera and Primitivo

Treatments:

- Untreated
- 0.15 lb actual P per vine (1/3 lb P per vine 0-45-0)
- 1.25 lb actual K per vine (2.5 lb of 0-0-50 KS04)
- 0.15 lb P + 1.25 lb. K
- 2.5 lb. K
- 0.15 lb P + 2.5 lb. K







Fertilizer applied March 1, 2010  
Petioles sampled June 14, 2010





# Fertilizer results

		Total	Total
		%	%
Description		P	K
Treatment			
Sampled 6/14/2010			
Barbera 1 Pet	<u>Untreated</u>	<u>0.41</u>	<u>3.66</u>
Barbera 2 Pet	0.15 lb P	0.64	3.92
Barbera 3 Pet	1.25 lb. K	0.44	3.92
Barbera 4 Pet	0.15 lb P+ 1.25 lb.K	0.63	3.89
Barbera 5 Pet	2.5 lb. K	0.48	3.83
Barbera 6 Pet	0.15 lb P + 2.5 lb. K	0.59	3.98
Primitivo 1 Pet	<u>Untreated</u>	<u>0.54</u>	<u>1.63</u>
Primitivo 2 Pet	0.15 lb P	0.73	1.71
Primitivo 3 Pet	1.25 lb. K	0.52	2.43
Primitivo 4 Pet	0.15 lb P+ 1.25 lb.K	0.66	2.01
Primitivo 5 Pet	2.5 lb. K	0.44	1.87
Primitivo 6 Pet	0.15 lb P + 2.5 lb. K	0.58	1.67
Barbera on 1103P, Primitivo is on St. George			
1103P tends to increase P uptake in literature			
St George tends to increase K uptake in literature			

Petiole sampling is a valuable tool:

P uptake demonstrated in both trials.

K higher in all treatments; rootstock effect.

\*\*Thank you to DellaValle Lab

Christensen threshold for P is 0.15-0.20 (DellaValle 0.2-0.5)

For K is 1.5 (DellaValle 2-3)

10/11/2010

**Barbera  
Untreated**



**Barbera  
0.15 lb P + 2.5 lb. K**



# Grapevine Leafroll Associated Virus Studies



# Recall 2008: Local “red leaf” investigation with Amador growers

- 12 blocks: various symptoms; scion/rootstock combinations; fertilizer practices.
- Complaints: won't ripen, can't get sugar levels up, “chocolate to burnt” leaf color symptoms; turns red after veraison.
- Sampled for virus panel 9/24/08 and sent to Golino lab
- **Goal: to identify which viruses are present in the region.**



Sue Sim,  
FPS

# 2008 virus testing results (PCR method)

## Leafroll virus testing results:

- Several samples + for
  - GLRaV-2, graft transmissible. (not mealybug vectored)
- A few samples + for
  - GLRaV-3, which is graft and mealybug transmitted.


## Other virus testing results:

- Several samples + for
  - GVB.
- A couple samples + for
  - GVD, gives red leaf symptoms.
- Several samples + for
  - GFkV. (mealybug transmitted?? Symptoms in *V. rupestris*; otherwise not economically important...we think)
- Several samples + for
  - RSPaV (common; not economically important?)

Almost all samples that were positive for one virus *also were positive for at least one* other virus.

## 2008 conclusions:

### What does this all mean?

- Viruses in grapevines are *really common* .
- Our knowledge is relatively “young”-only researched for 20-30 years and detection is improving.
- We do not know much about other vectors (i.e. Phylloxera?)
- Use CERTIFIED WOOD if you can.
- Do not top work graft onto rootstock that had a scion that showed virus symptoms. Rootstock  Scion
- If field selected, visit the field the fall before and flag vines without symptoms to take budwood from.
- Remember you still may see symptoms if you use a different rootstock, or if your cultural conditions are different (i.e. leafroll doesn't show symptoms on own rooted).

## 2010 Collaborating Projects:

### **Investigating Grapevine Leafroll Associated Virus (GLRaV) Genetic Diversity and Distribution**

Rodrigo Almeida, Monti Sharma, Breanna Baraff, Kent Daane, John  
Hutchinson (UC Berkeley)



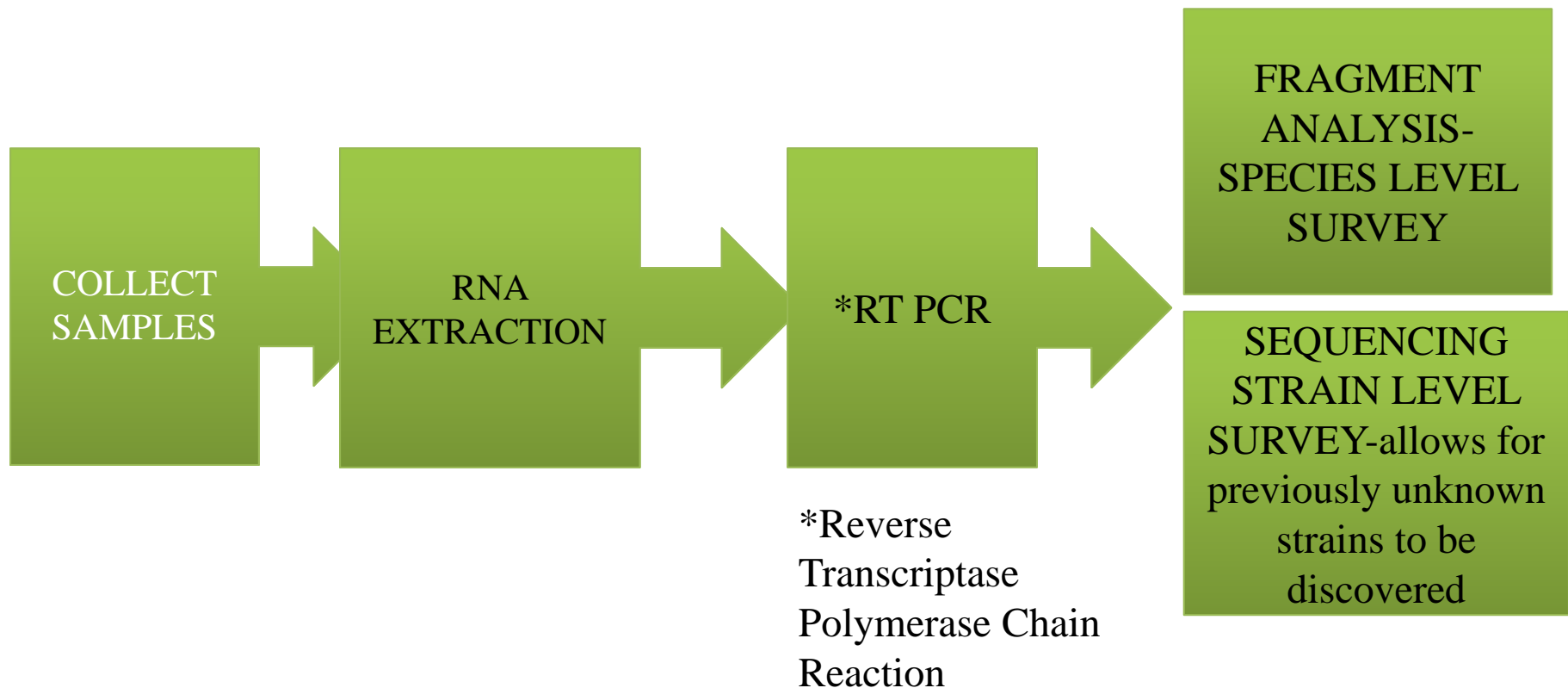


**Research questions:** What species of *Grapevine leafroll-associated virus* are present in Amador, El Dorado, San Luis Obispo, and Lodi California?

**Hypothesis:** *Grapevine leafroll-associated virus-3* is the most prevalent species of the virus in California.

# Methods

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Amplifies the RNA so that small quantities can be detected.

Fluorescent dye used to detect virus RNA.

# Samples Collected Fall 2010

Varieties sampled:

Barbera

Cabernet Franc

Gamay

Merlot

Petite Sirah

Pinot Noir

Primitivo

Zinfandel

Site	Number of Vineyards	Total Samples
San Luis Obispo	5	149
Lodi	8	167
Amador & El Dorado	12 (4 in Amador, 8 in El Dorado)	232
		Total: 548



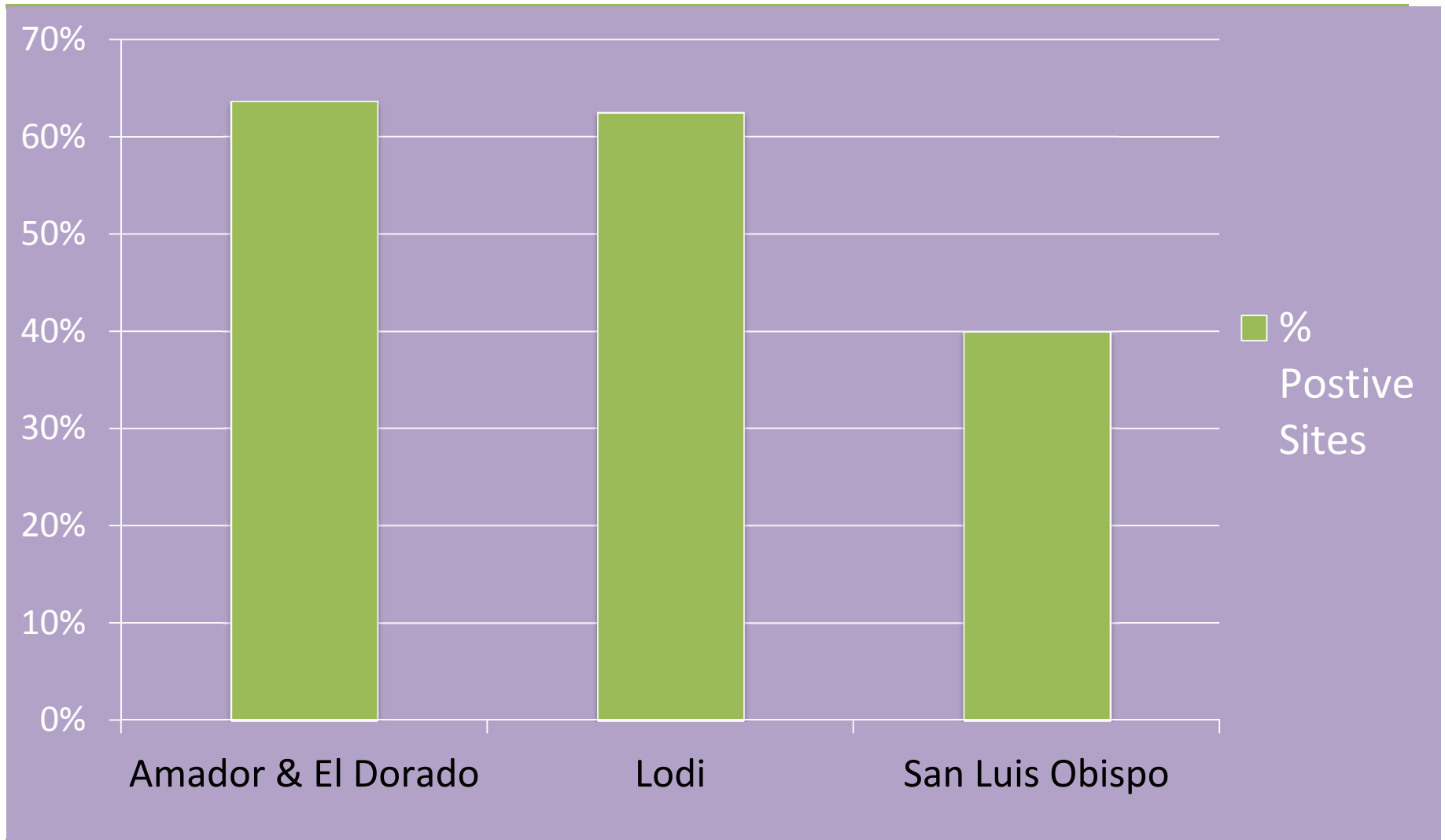
Samples NOT random;  
collected from suspect  
sites with symptoms.

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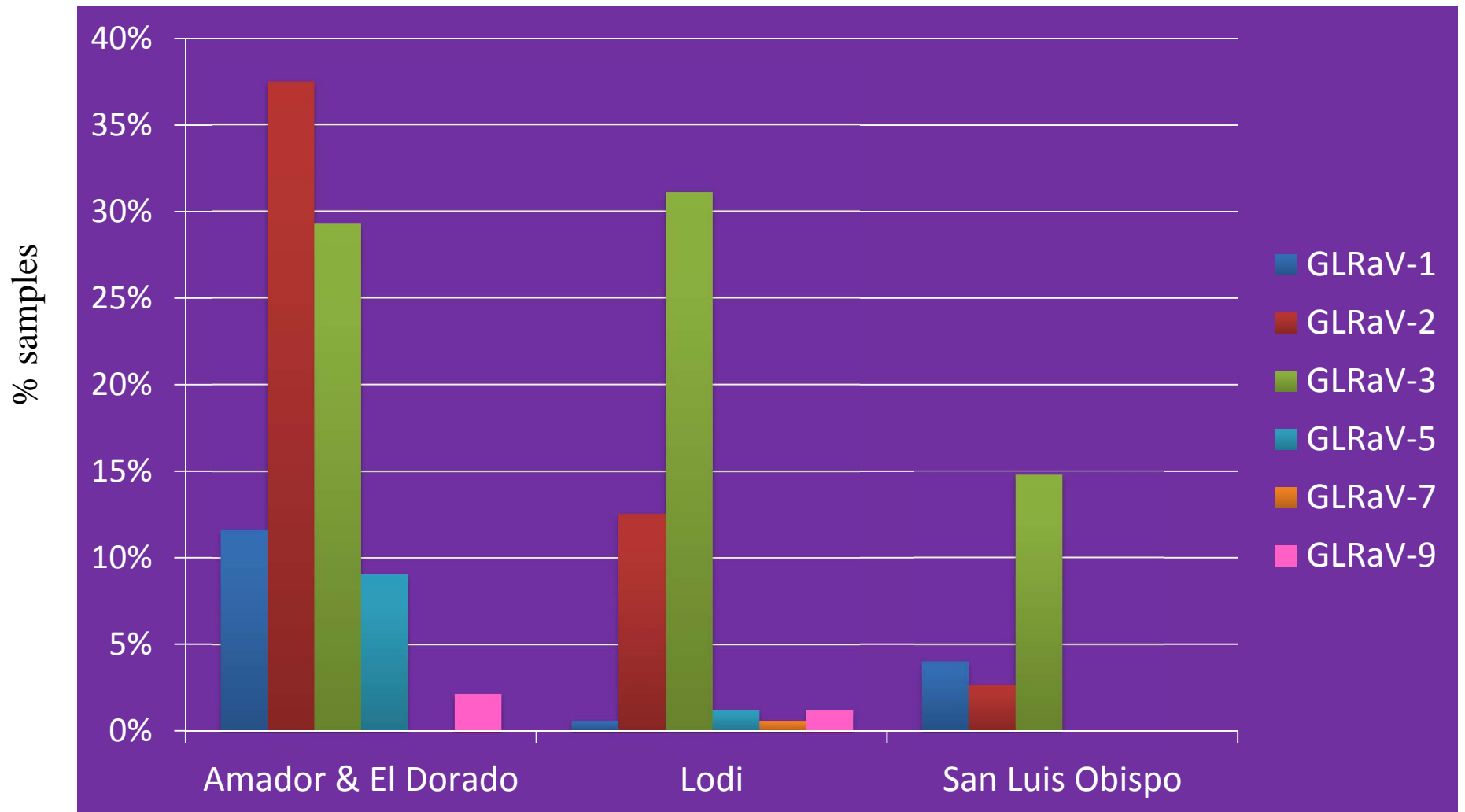
**2010 RESULTS:  
ALMEIDA LAB**

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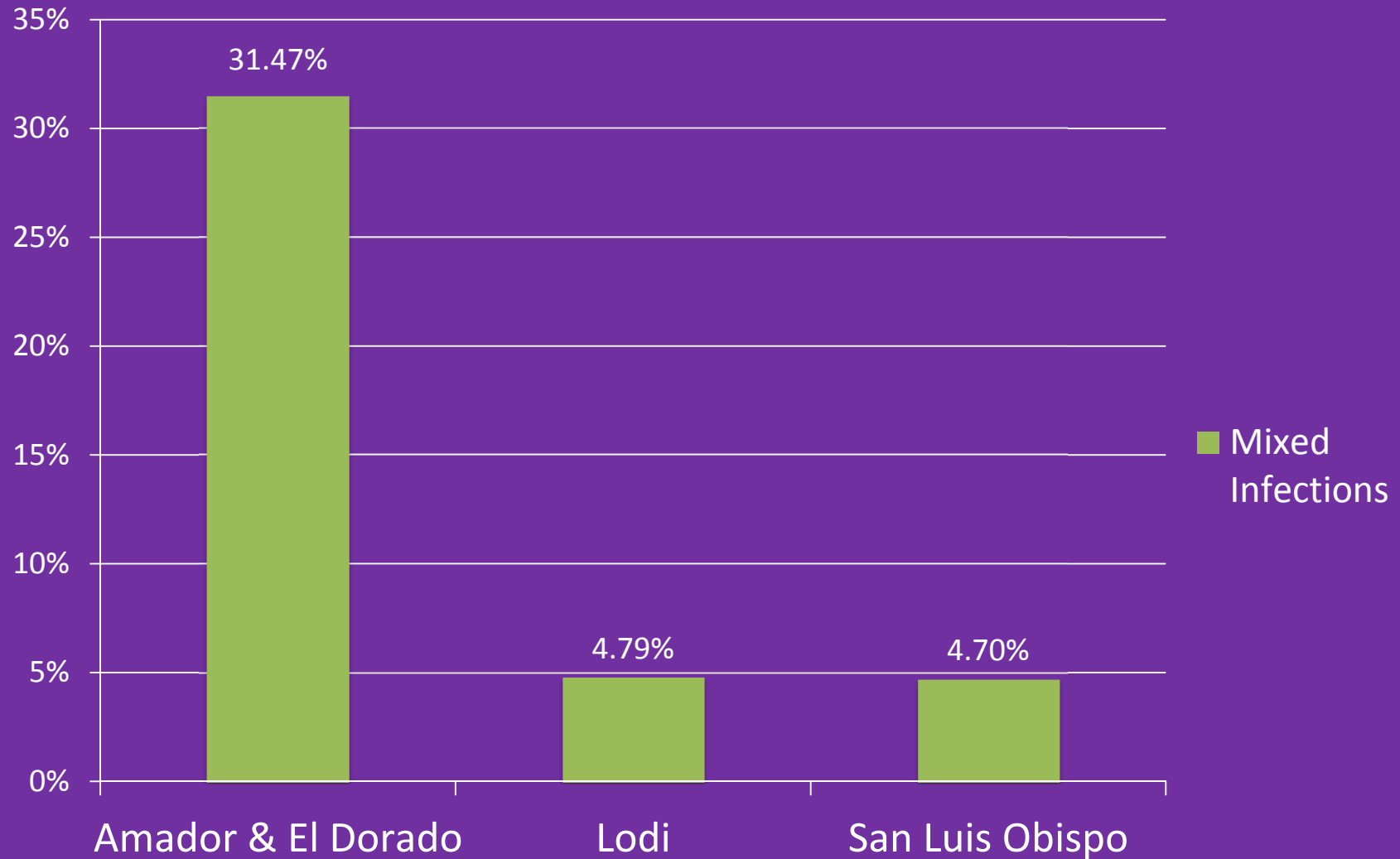
# % Positive Sites



# Species of GLRaV



# Multiple Species Infections



# Strains *GLRaV-3*

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- San Luis Obispo: strains A, B, C, E
  - Lodi: strains A, B, C, G
  - Amador & El Dorado: strains A, B, C
  - Strains in these regions aren't unique, they have been found around the world
-



# Why should you care?

Pinot Noir



# What about our case study site?



# What about our case study site?

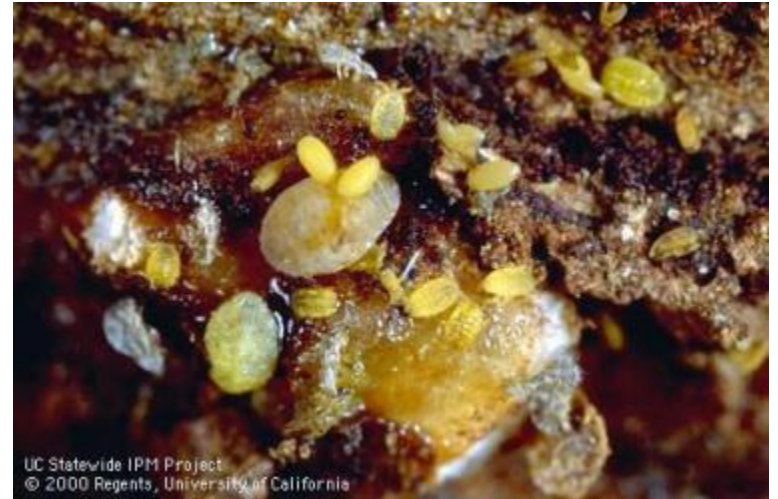
- Included in 2010 Berkely RNA fragment analysis
- Originally came back negative
  - Sampled late in season (Nov. )-virus titer low?
  - Virus titer unevenly distributed in vine (one petiole sampled per vine)
- Spoke with Monti Sharma (UCB), requested a second look
- Monti found 2 samples via sequencing and newly designed sequencing primers correlating with LR-5, possibly a new strain (current detection primers could not detect)
- Possible other effects: drought induced nutritional deficiency? B deficiency in Primitivo?

**Collaborating project:  
Testing Phylloxera for leafroll transmission  
Kent Daane and Christina Wistrom, UC Berkeley**



# Phylloxera

- Tiny, aphid-like insect, *Daktulosphaira vitifoliae*
- Feeds on *Vitis vinifera* roots-stunting vines, sometimes killing them.
- Why rootstocks developed
  - St. George (*V. rupestris*)
  - 110R (*V. berlandieri* x *V. rupestris*)
  - 3309C (*V. riparia* x *V. rupestris*)



# Can Phylloxera transmit leafroll virus?

- 13 vines from 4 blocks sampled in Amador county in Nov., 2010
- Blocks showed suspect signs of Phylloxera *and* leafroll *and* were own-rooted *and* not treated for Phylloxera
- Petioles and roots sampled and were tested for leafroll virus (strains 1, 2, 3, 5 and 9) using rapid RNA technique
- Roots washed and inspected for Phylloxera nymphs
- Phylloxera nymphs recovered were tested for leafroll virus



11/17/2010 11:52

# Results

- 23% sampled vines had Phylloxera recovered from roots (even in apparently sandy soils).
- None of the roots or the Phylloxera tested positive for leafroll.
- 38% of the sampled petioles tested positive for leafroll.
- All positives were for GLRaV-2
- Will repeat this year.




# Conclusions

## *Increasing our local knowledge of “red leaf”*

- Leafroll virus is common in the foothills
- GLRaV-1, 2, 3 (a,b,c), 5,9 found in our region
- Multiple infections common
- Mealybugs (vectors) becoming more prevalent
  - Viable management options that preserve parasitoids demonstrated
    - Applaud, Assail
  - Future work testing Gill’s mealybug for transmission ability
- So far Phylloxera negative for transmission ability
  - Testing continuing this year
- Sampling petioles at flowering will pick up fertilizer management



# Looking back at 2008 conclusions: What does this all mean?

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Thank You!  
Questions??