Grapevine Red Blotch Disease

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Yr. 2008

UCDavis-VES: Cabernet Sauvignon 4/101-14

- Grapevines showed symptoms resembling leafroll.

- Tested negative for known grapevine viruses.

- Reduced sugar (°Brix) in the juice.

- Delayed harvest.

Yr. 2009

Oakville:	**Cabernet Franc 214/101-14**
	Cabernet Sauvignon/101-14
Calistoga:	**Several scions on AXR-1**
	(Cabernet Sauvignon, Merlot, and Zinfandel)
Rutherford:	**Cabernet Sauvignon 337/039-16**

Cabernet Franc, Sept 2009

“Grapevine red blotch”

Red blotch on Cabernet Sauvignon, St. Helena, Fall 2012.

Malbec, Napa County, 2013

Red blotch on Merlot, Calistoga, Sept 2011

Red blotch on Merlot, Napa, Aug 2012

Pinot Noir, Napa County, 2013

Red blotch can be nasty in Zinfandel due to drought and hot summer, Mendocino County, Sept 2014.

Rousannè
(Paso Robles, Nov 2013)

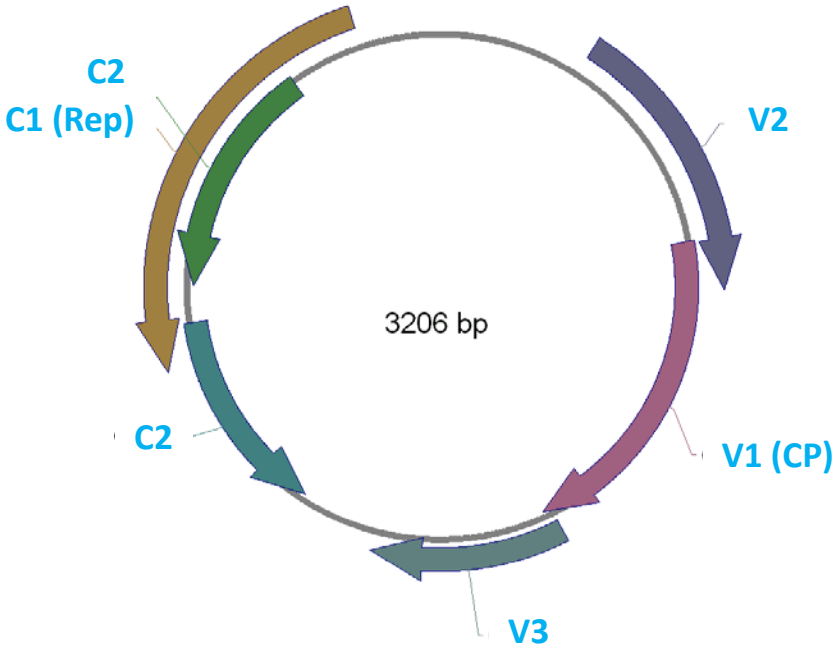
White Riesling, Napa County, Sept 2013.

Chardonnay, Sonoma County,
Sept 2013

Red blotch

Leafroll

Cabernet Franc



Grapevine red blotch-associated virus (Al Rwahnih et al., 2012)
= Grapevine Cabernet Franc-associated virus (Krenz et al., 2012)
= Grapevine Red Leaf-associated virus (Poojari et al., 2013)
= Grapevine geminivirus (Seguin et al., 2014)

Cabernet Franc at Oakville, Oct 2012

Nov 2011

A Private lab Test Report on Virus Testing of Grapevines, Oct 2012

Variety	Rootstock	Symptoms	USDA test for GRBaV	GRBaV	LR1	LR2	LR3	SyV	GVB	GFLV	Xf	RSP-Sy
Merlot	420A	Yes	POS	POS	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
Merlot	420A	No	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
Cab S	420A	Yes	POS	POS	NEG	NEG	NEG	NEG	NEG	NEG	NEG	POS
Cab S	420A	No	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	POS
Merlot	420A	Yes		POS	NEG	NEG	POS	NEG	NEG	NEG	NEG	NEG
Merlot	1103P	No		NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
Cab S	420A	No	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
Cab S	420A	Yes		POS	NEG	NEG	POS	NEG	NEG	NEG	NEG	NEG
Cab S	420A	Yes		POS	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
Cab S	420A	Yes		POS	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
Cab S	420A	No		POS	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
Cab S	420A	Yes		POS	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
Cab S	420A	No		NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
Cab S	1616C	Yes	POS	POS	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
Cab S	1616C	No		NEG	NEG	NEG	NEG	POS	NEG	NEG	NEG	NEG

Agri-Analysis tests

Juice quality of Cabernet Sauv grapevines at harvest

Status	Number of vines	PCR	Mean	Titratable Acidity	pH	Anthocyanin	Catechin /tannin
Yr 2012							
Red blotch	5	POS	21.9± 0.26	7.80	3.34	658	0.09
Green	5	NEG	27.8± 0.25	4.91	3.68	782	0.07
Yr 2013							
Red blotch			23.2	4.6	3.49	904	0.06
Green			25.5	4.1	3.71	1298	0.03

2013 Fall

June 2015

Napa Cabernet Sauvignon — Wine Revenue Scenarios

Price/Bottle	FOB Case Price	Tons/Acre	Revenue/Acre
$25	$150	5.0	$39,000
$50	$300	4.0	$62,400
$100	$600	3.0	$90,000
Red blotch vines	Bulk at $24/gallon	3.0	$10,800

(Franson, P. 2014. Wines & Vines 2.07.2014)

http://www.winesandvines.com/template.cfm?section=news&content=127859#.Uvgwa6CXnyc.email%3E

Is Grapevine red blotch-associated virus spreading in the vineyards?

GRBaV Incidence

None to extremely low

None to moderate

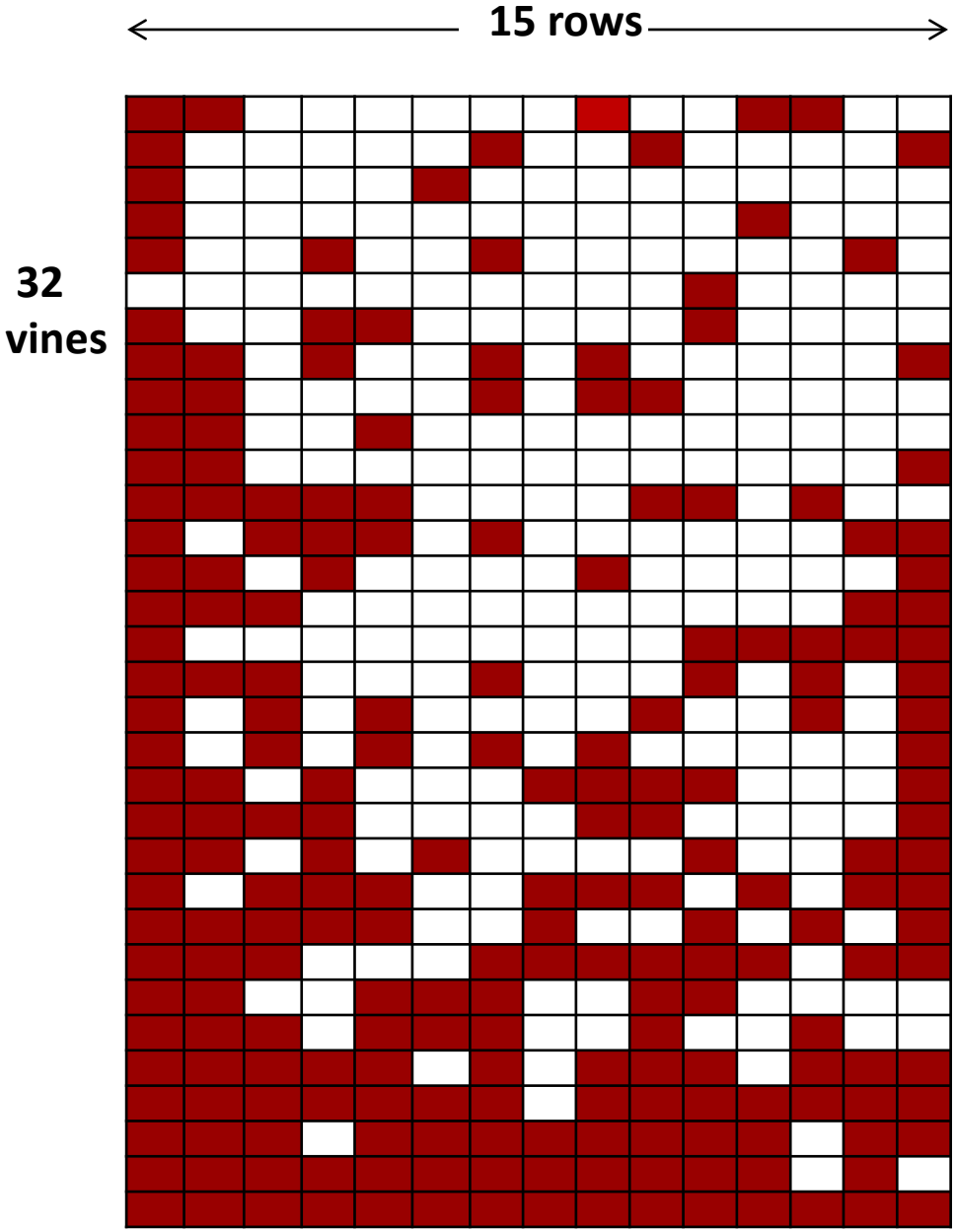
Low to very high

Poojari et al., 2013. PlosOne 8:e64194

http://www.agf.gov.bc.ca/cropprot/grapeipm/leafhopper.htm

Vineyards with red blotch (RB) disease confirmed as Infected by Grapevine red blotch-associated virus

RB	Location	Clone	Virus Detected	Year block Removed
2008	Rutherford	Cab Sauvignon	!	2010
2009	Oakville	Cab Sauvignon	2011	2015
2009	Oakville	Cab Franc	2011	2014
?	St. Helena	Petite Sirah	2011	No access
?		Petit Verdot	2011	No access
2011	Napa	Cab Sauvignon	2011	2013
2011	Sonoma	Cab Sauvignon	2012	
2011	Napa-Oak Knoll	Merlot	2012	2013
?	Shandon	Merlot	2012	2013
		Mourvédre	2012	2013
2012	Napa	Cabernet Franc	2013	2013
2013	Rutherford	Cab Sauvignon	2013	2013 (!)



Red blotch disease incidence at Oakville Station, Sept 2011

223/480 (46%)

Yr of Planting 2001

Rootstock 2001, budded spring 2002

parking lot

A1 row

vine	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1	11	11					12		11			11	11	13	13
2					13		11			14		13			11
3	11				13	11		13				14			13
4						12						11	13	13	13
5	11	14	14				11			13				11	14
6					13					14	11				13
7	11	14	13		11	14	14				11			14	
8	11	11		11			11					12			11
9	11	11					11			14		12			
10		11	12		11				12	12				13	
11	11	11	13						12	14		14	13	12	11
12	11	11	11	11	11						11		11		13
13	11	14	11	11	11		11				13		14	11	11
14	11	11		11					11						11
15	11	11	11	12								14		11	11
16	11	14									11	11	11	11	11
17	11	11	11	13			11		13				11	12	11
18	11		11	13	11				12	11			11		11
19	11	14	11		11		11	14	11			14	14		11
20	11	11	12	11				11	11	11	11				11
21	11	11	11	11		14			11	11					11
22	11	11	12	11		11		14			11			11	11
23	11	12	11	11	11			11	11	11		11		11	11
24	11	11	11	11	11	14	14	11	12		11	12	11		11
25	11	11	11			13	11	11	11	11	11	11		11	11
26	11	11	12		11	11	11			11	11			12	12
27	11	11	11	12	11	11	11			11			11		
28	11	11	11	11	11	12	11	12	11	11	11		11	11	11
29	11	11	11	11	11	11	11	12	11	11	11	11	X	11	11
30	11	11	11	12	11	11	11	11	11	11	11	11	12	11	11
31	11	11	11	11	11	11	11	11	11	11	11	11		11	
32	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Yr 2011 - 46.5% (Clade 1)
Yr 2012 - 51.4% (Clade 1)
Yr 2013 - 56% (Clade 2)
Yr 2014 - 63.4% (Clade 2)

Michael Anderson
UCD, Vit&Enol

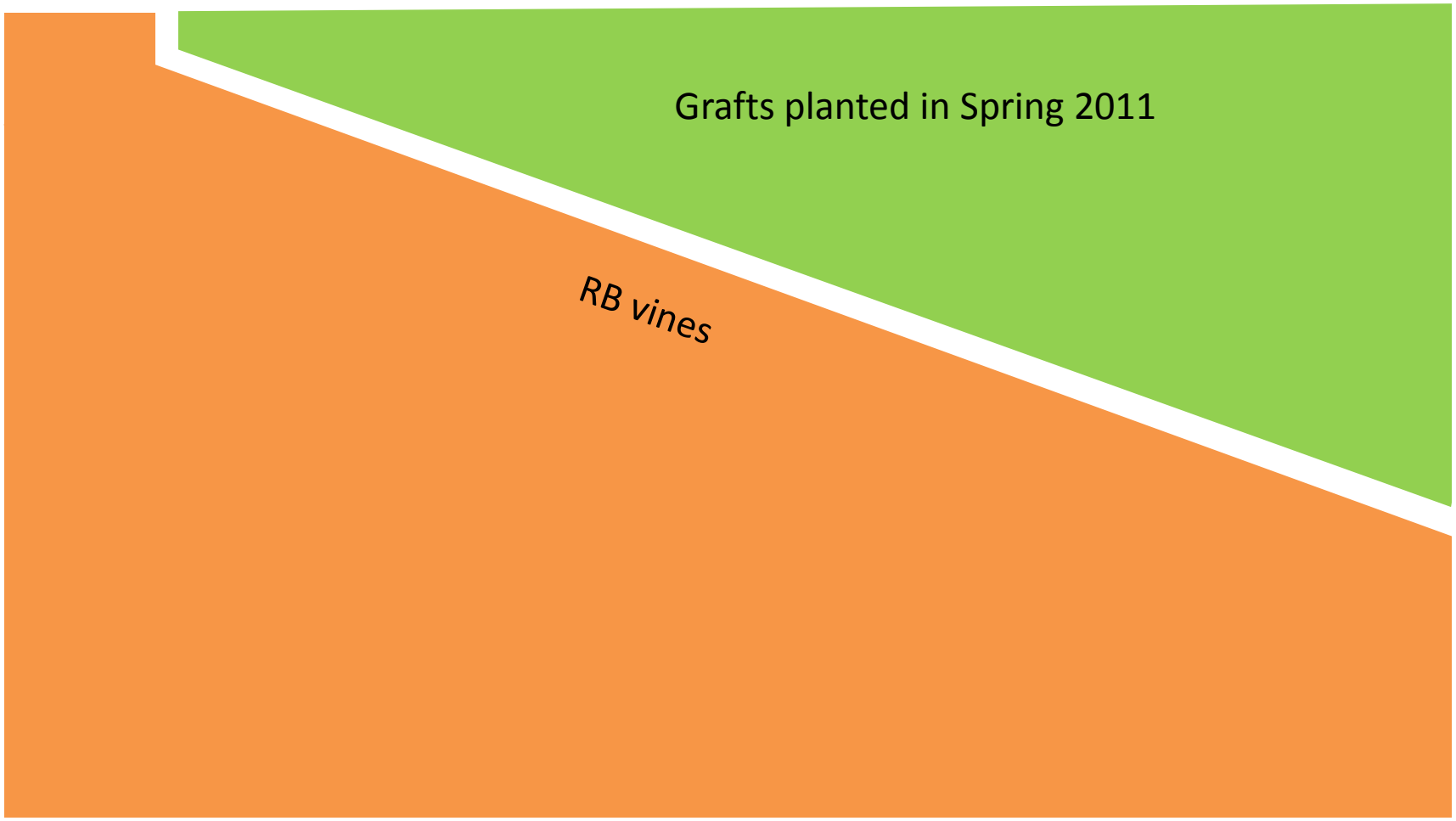
Cabernet Sauvignon
(Fall 2014)

Cabernet Franc, Napa County, 2013

Cabernet Franc with Red blotch, 2013

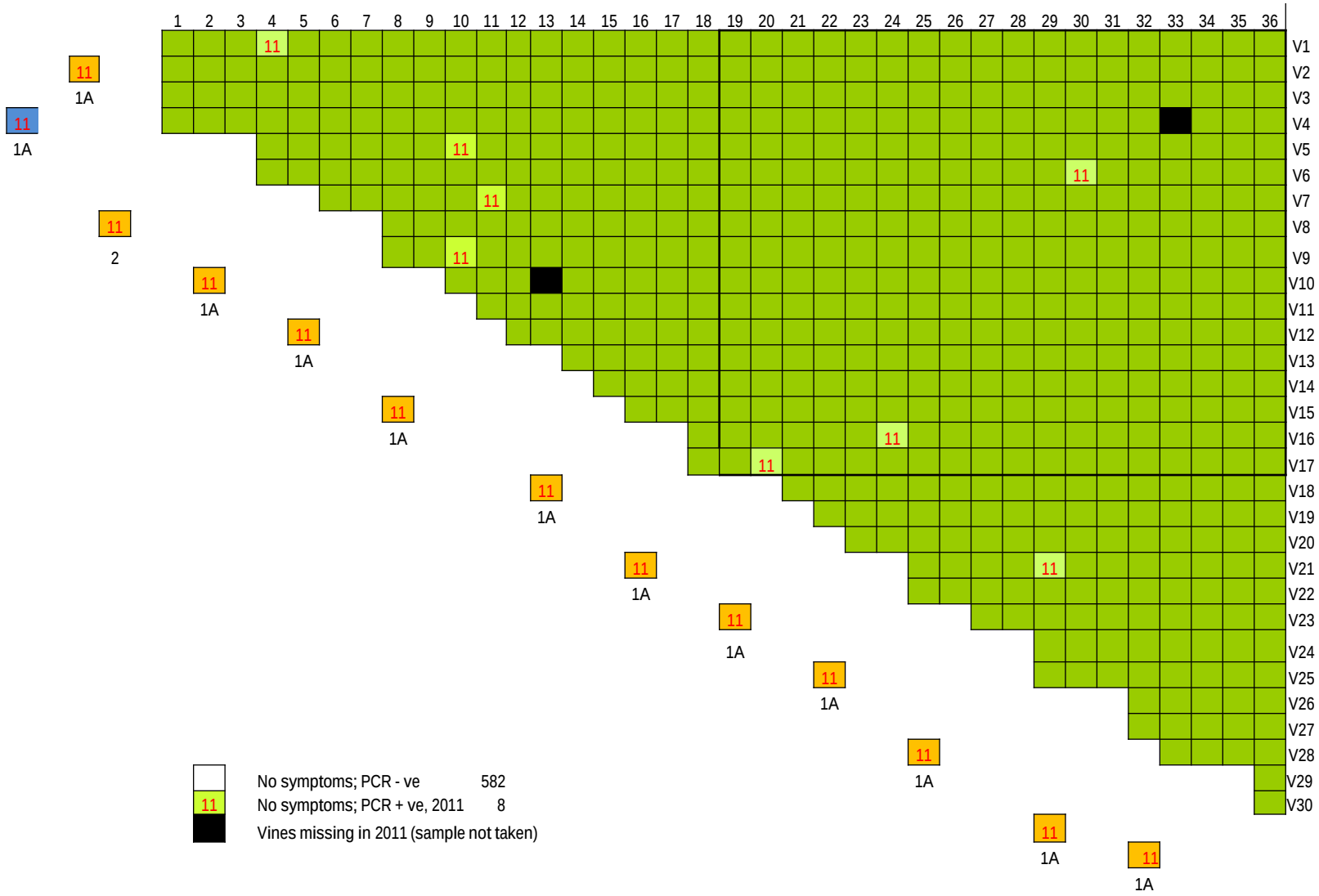
Cabernet Franc with Red blotch
(Fall 2013)

Paved Road




October, 2011

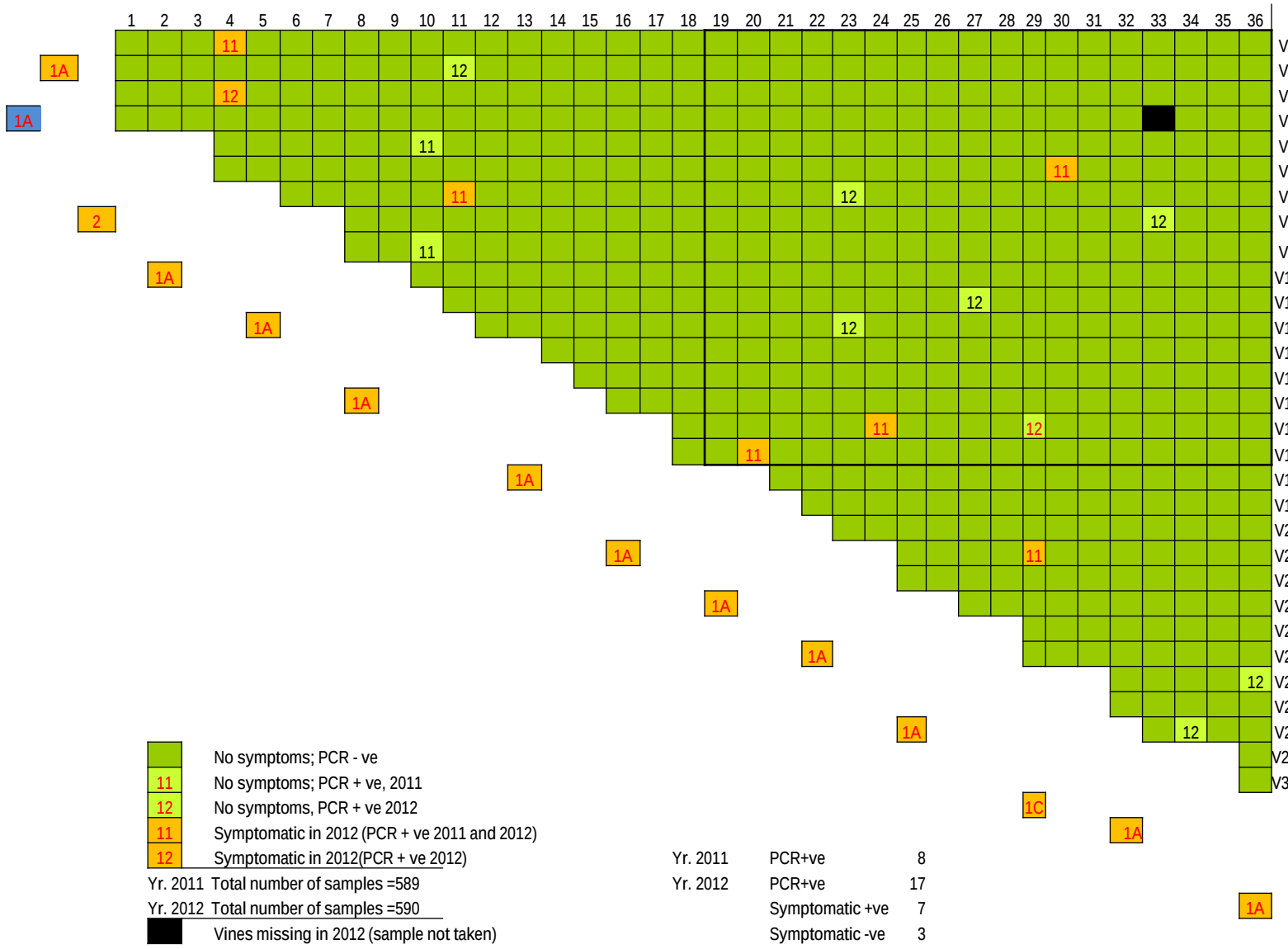
Year 2011



Incidence of GRBaV in a 2011 planting of Cab Sauvignon (Year 2011)

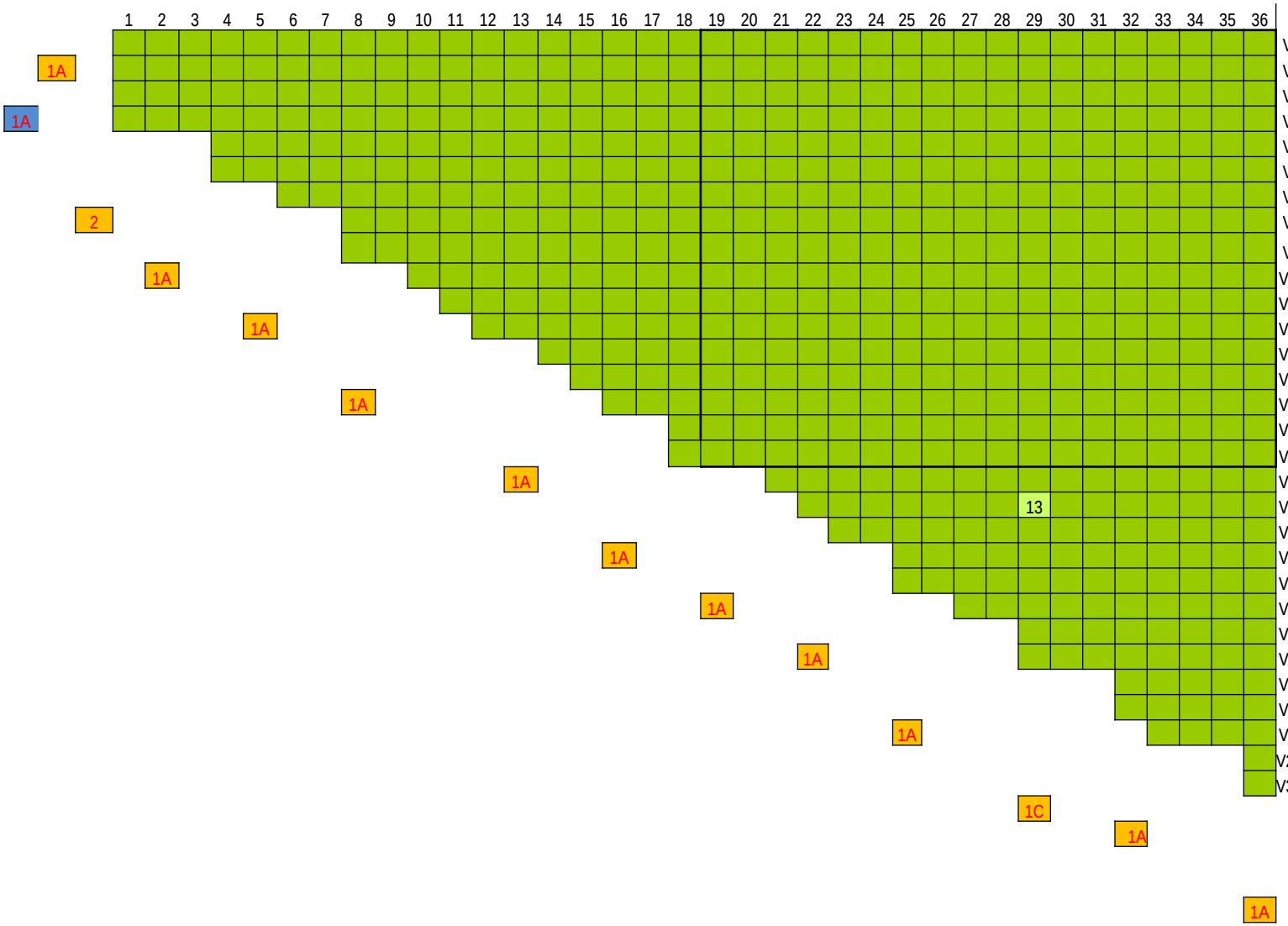
11 1A

Year 2012



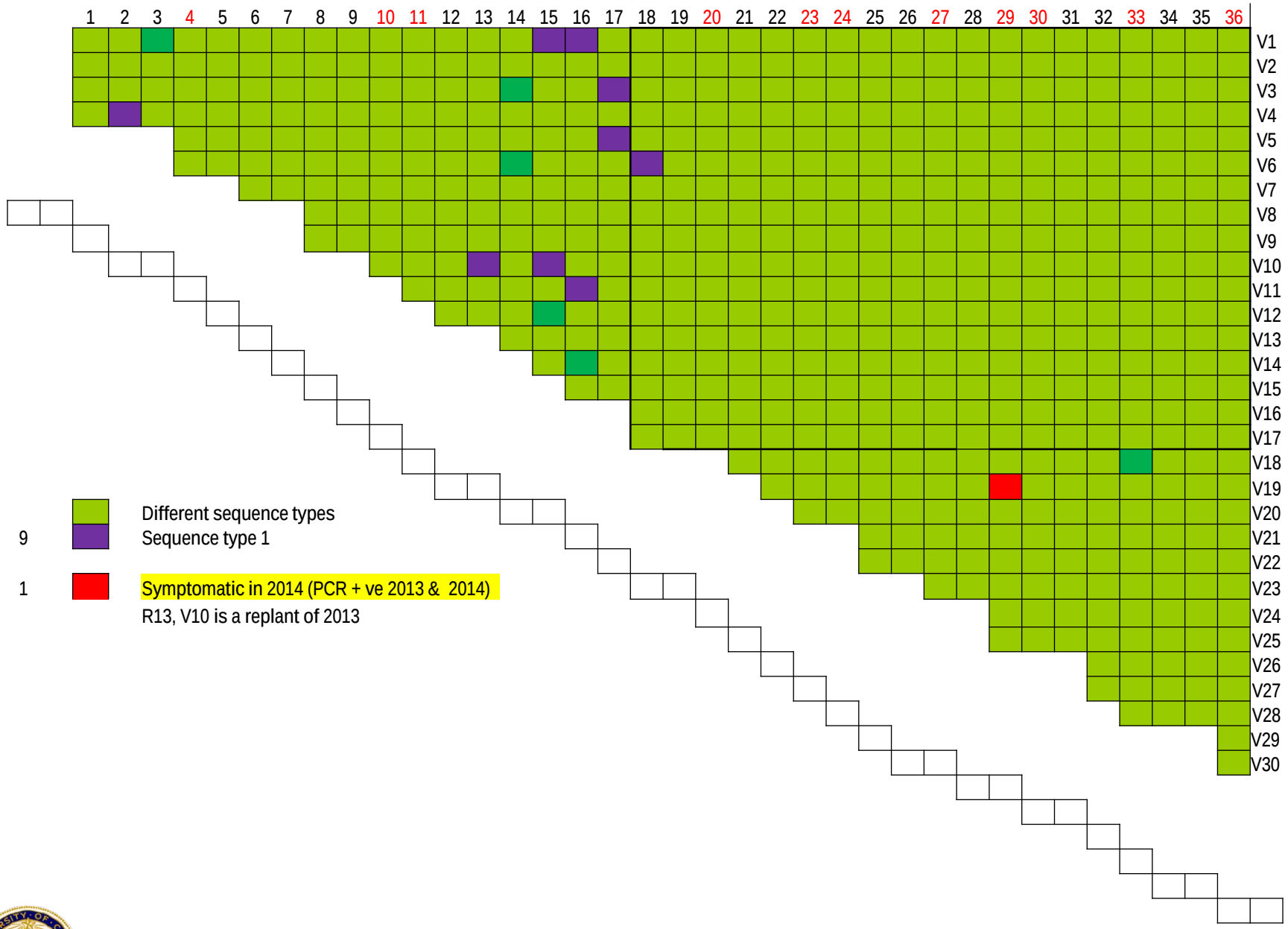
Incidence of GRBaV in a 2011 planting of Cab Sauvignon (Year 2012)

Year 2013

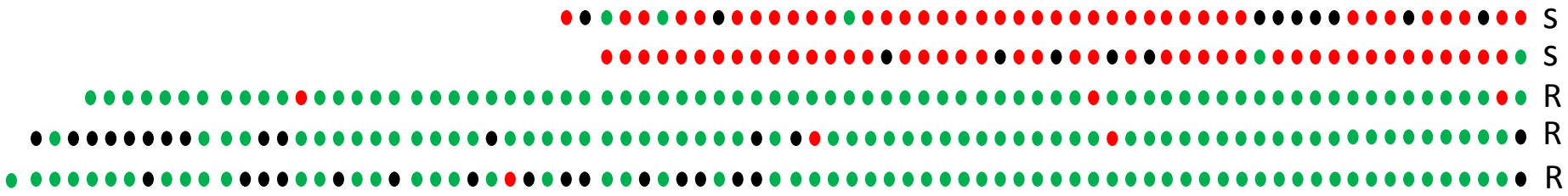


Incidence of GRBaV in a 2011 planting of Cab Sauvignon (Year 2013)

Year 2014


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
V1 V2 V3 V4 V5 V6 V7 V8 V9 V10 V11 V12 V13 V14 V15 V16 V17 V18 V19 V20 V21 V22 V23 V24 V25 V26 V27 V28 V29 V30
Different sequence types
9 Sequence type 1
1 Symptomatic in 2014 (PCR + ve 2013 & 2014)
R13, V10 is a replant of 2013

Status of GRBaV infection in scion rows and rootstock rows (Early Spring 2014)



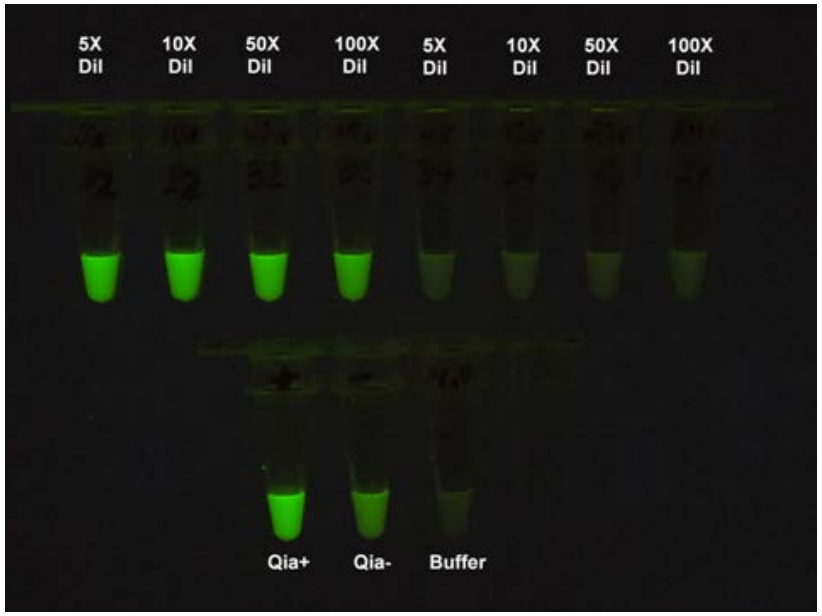
- PCR negative
- GRBaV-Infected
- Vine missing

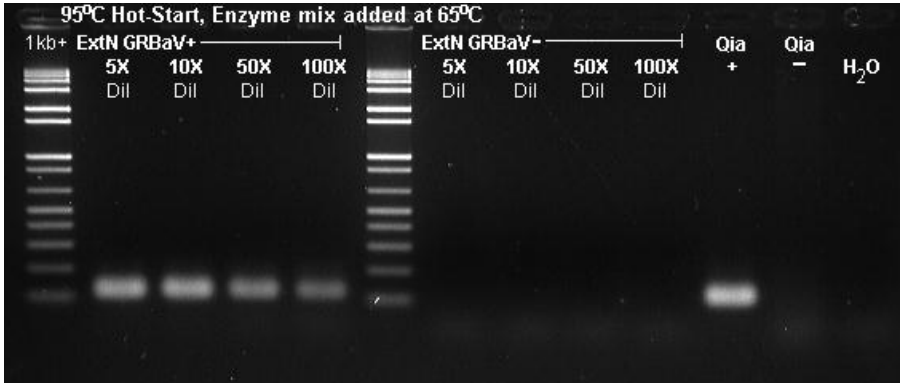
Virginia creeper leafhopper on blackberries next to grapevine, March 2014

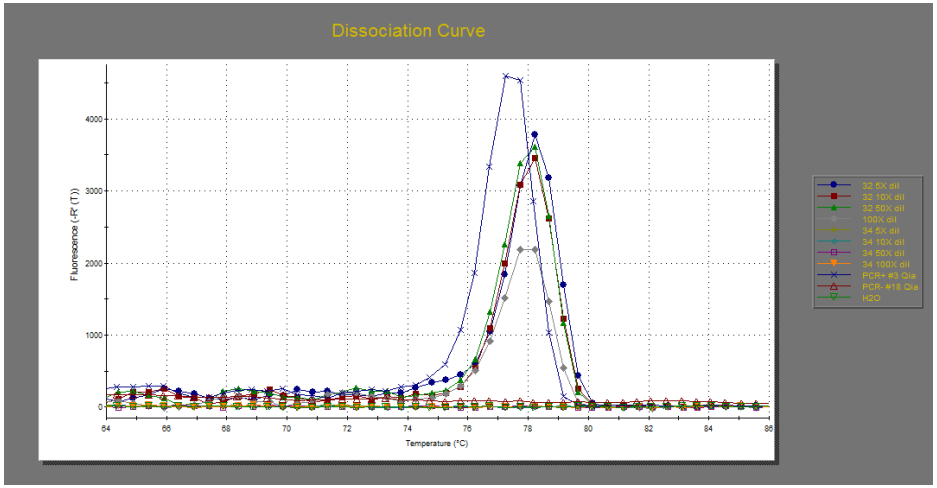
Hopper damage on grapevines,
May, 2014

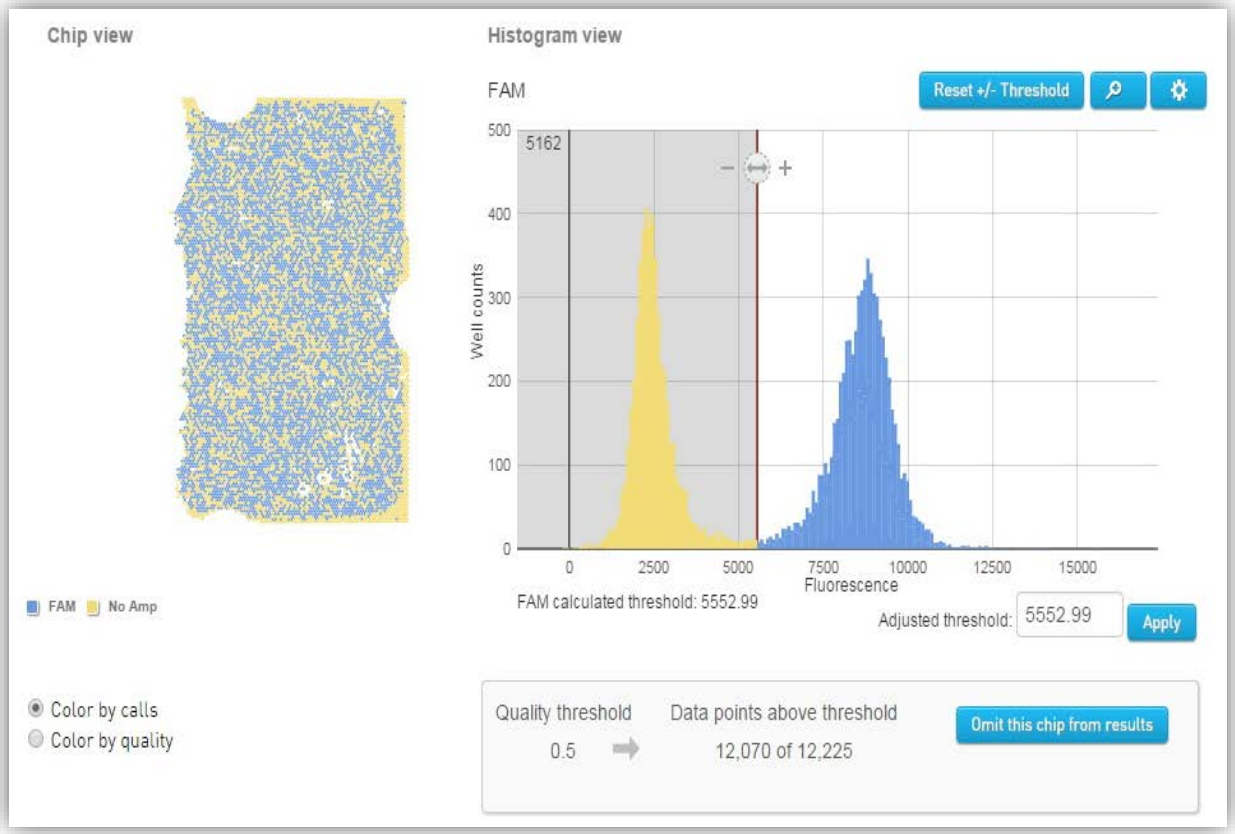
GRBaV detection by a simple plant DNA extraction followed by Isothermal amplification

Infected Plant extract Healthy plant extract









GRBaV
GLRaV-1
GLRaV-3

Maya Jayanth & Trent Lawler

Digital PCR using Quant3DStudio

Funding Sources

July 2012-June 2015	Fruit Tree, Nut Tree and Grapevine Improvement Advisory Board (IAB)
April 2013 –	American vineyard Foundation
Sept 2013 – Aug 2015	USDA National Plant Disease Recovery Program
July 2014-June 2015	California Grapevine Rootstock Improvement Commission
Oct 2014-June 2017	Specialty Crops Improvement Block Grant (CDFA)

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Vineyard Owners/Managers

Grapevine nurseries in California

Epidemiology of Grapevine red blotch-associated virus (USDA)

Evaluating the effects of Grapevine red blotch-associated virus on symptom development and fruit maturity

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