

Grapevine Survey for viruses of potential economic importance in Norton, Chardonel, and Vignoles



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The 2017 virus survey: Missouri vineyards tested for the presence of 26 different viruses

25 hybrid grape cultivars tested

400 samples collected in July through a prearranged pattern to avoid bias towards selection of virus-infected plants

Each sample was a composite of 4 vines (for a total of 1600 vines sampled)

Each sample tested for 26 different viruses

Table 2. Virus incidence in each cultivar

Virus	Survey Average	Vidal blanc	Vignoles	Chardone	Norton	Chambourcin	Valvin Muscat	Crimson Cabernet	Vivant	Vincent	Concord	Lenior	Albania	Hidalgo	Muench	Wetumka	Cloeta	Traminette	Catawba	Cayuga	Rayon	Saperavi	Cabernet franc	Noiret	Viognier	Foch
GRSPaV ³	58.7 ¹	100	100	46.7	0	100	100	0	15.0	80.0	0	0	0	0	0	0	0	36.4	0	0	100	100	100	0	100	100
GLRaV-3	52.7	91.1	88.5	33.3	85.0	3.3	10.0	0	10.0	0	100	40.0	100	40.0	100	100	0	0	100	50.0	50.0	0	0	0	0	100
GRBV	35.0	24.4	4.3	75.5	77.5	26.7	40.0	90.0	0	0	20.0	100	20.0	80.0	0	100	100	0	0	0	0	0	0	60.0	20.0	100
GVE	31.0	26.7	85.7	8.9	30.0	0	0	0	0	0	100	0	100	40.0	100	100	0	0	80.0	0	0	0	0	0	0	0
GLRaV-2	19.0	91.1	54.2	6.7	0	26.7	0	0	0	0	0	100	0	0	0	0	0	0	0	0	20.0	0	0	0	0	0
GVB	17.2	0	65.7	0	22.5	0	0	0	0	0	10.0	60.0	40.0	0	20.0	100	0	0	80.0	0	10.0	0	0	0	0	0
GVkV	13.5	28.9	38.5	0	15.0	3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40.0	0	0	0	0	40.0
GLRaV-2RG	9.2	0	1.4	0	72.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60.0	0	0	0	0	0
GVCV	8.2	33.3	1.4	24.4	0	0	20.0	0	0	0	0	0	0	0	0	0	0	0	0	10.0	0	0	0	10.0	10.0	0
GVA	0.5	0	0	0	2.5	3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GLRaV-5	0.2	0	0	2.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sample # ²	400	45	70	45	40	30	20	10	20	10	10	5	5	5	5	5	5	11	5	10	10	4	5	10	10	5

¹This value is the percentage of the composite samples positive for the selected virus.

²The number of composite samples collected for each cultivar.

³Virus acronyms: GRSPaV, Grapevine stem pitting associated virus; GLRaV-3, grapevine leafroll associated virus 3; GRBV, grapevine red blotch virus; GVE, Grapevine virus E; GLRaV-2, Grapevine leafroll associated virus 2; GVB, Grapevine virus B, GVkV, Grapevine fleck virus, GLRaV-2RG, Grapevine leafroll associated virus 2RG; GVCV, Grapevine vein clearing virus; GVA, Grapevine virus A, GLRaV-5, Grapevine leafroll associated virus 5.

Virus Composition in Norton at each of Six Survey Sites

	Central Site 2	Hermann Site 1	Hermann Site 6a	Hermann Site 6b	Southeast Site 1	Central Site 1	Total	Total Entire Survey
One Virus								
GLRaV2RG	1						1	1
GLRaV3	1						1	7
GRBV					1		1	31
Two viruses								
GLRaV3, GRBV	1				1	2	4	7
GLRaV2RG, GRBV					3	1	4	4
Three viruses								
GLRaV3, GRBV, GLRaV2RG			2		2		4	4
GLRaV3, GRBV, GVB	1					1	2	2
GLRaV3, GRBV, GVE	1				1		2	3
GLRaV3, GRBV, GFkV						1	1	1
GLRaV3, GLRaV2RG, GVB			1				1	1
GLRaV3, GLRaV2RG, GVE		5					5	5
Four viruses								
GLRaV3, GRBV, GLRaV2RG, GVB	3				1		4	4
GLRaV3, GRBV, GLRaV2RG, GVE				4			4	4
GLRaV3, GRBV, GLRaV2RG, GFkV	1						1	1
GLRaV3, GLRaV2RG, GFkV, GVB			1	1			2	2
Five viruses								
GLRaV3, GRBV, GLRaV2RG, GFkV, GVB			1				1	1
GLRaV3, GRBV, GLRaV2RG, GFkV, GVA	1						1	1
GLRaV3, GRBV, GLRaV2RG, GFkV, GVE					1		1	1
Total number of samples at each site								
	10	5	5	5	10	5	40	

Effect of GRBV and GLRaV-3 on *Vitis vinifera*

Reduced vine growth

Reduced fruit yield

Reduced sugar in fruit juice

Higher pH in fruit juice

Higher titratable acidity in fruit juice

Lower anthocyanins and tannins in berry skin

Virus infections affect wine quality through disruption of ripening pathways involved in the generation of color, flavor and aroma compounds

Impact of virus infections on Missouri Wine Grapes

Grapevine red blotch virus and Grapevine leafroll-associated viruses have been documented to affect vine health and berry quality in vineyards in California.

GVCV affects vine health. Its effect on berry quality has not yet been characterized

These viruses are present at high levels in some grape hybrid cultivars grown in Missouri

However, it is unknown how these viruses affect grape cultivars in Missouri

One example: Some cultivars may exhibit symptoms of GRBV, whereas others are asymptomatic

Chambourcin



Crimson Cab



Norton



GRBV-
positive

GRBV-
negative



What effect do viruses have on vine health and berry quality?

1. Which virus combinations are most likely to occur in the cultivars Norton, Chardonel and Vignoles?
2. What is the impact of virus infection on the accumulation of Brix, pH, and titratable acids at harvest in Norton, Chardonel and Vignoles?
3. What is the effect of virus infections on soluble sugars in leaves?

Goal: identify vines infected with individual viruses as well as specific virus combinations.

We collected tissues from 50 vines each at three locations for each cultivar for a total of 150 Norton, 150 Vignoles and 150 Chardonel vines.

Each vine was tagged to allow for collection of canes and retesting in subsequent years.

Selection of Norton, Chardonel, and Vignoles – 2017 Survey

	GRBV	GVCV	GLRaV-3	GLRaV-2/2RG
Norton site 1	5/5	0/5	4/5	1/5
Norton site 2	4/5	0/5	5/5	5/5
Norton site 3	6/10	0/10	9/10	6/10
Chardonel site 1	5/5	1/5	1/5	1/5
Chardonel site 2	4/5	1/5	4/5	0/5
Chardonel site 3	10/10	7/10	2/10	1/10
Vignoles site 1	0/10	0/10	10/10	0/10
Vignoles site 2	0/10	0/10	10/10	3/10
Vignoles site 3	n/a*	n/a	n/a	n/a

A new site – not included in the 2017 survey

Selection of Norton, Chardonel, and Vignoles – 2020 Survey

	GRBV	GVCV
Norton site 1	0%	n/a
Norton site 2	48%	n/a
Norton site 3	30%	n/a
Chardonel site 1	18%	0%
Chardonel site 2	44%	42%
Chardonel site 3	92%	18%
Vignoles site 1	0%	0%
Vignoles site 2	0%	0%
Vignoles site 3	14%	0%

Screening Chardonel at one site for GRBV (🔴) and GVCV (🟢)
(ten vines in each of five rows)

201 🔴	211 🔴🟢	221 🟢	231 🟢	241
202 🔴🟢	212	222 🔴🟢	232 🟢	242
203 🔴	213	223 🟢	233	243 🟢
204 🔴	214	224 🟢	234 🟢	244 🔴🟢
205 🔴	215 🔴	225 🟢	235 🔴	245 🔴
206 🔴	216 🔴	226 🟢	236 🔴	246 🟢
207	217 🔴	227 🟢	237 🔴	247
208	218 🔴🟢	228 🟢	238	248
209 🔴	219 🟢	229 🟢	239 🔴	249
210 🔴	220 🟢	230 🟢	240	250

Screening Chardonel at one site for GRBV (🔴) and GVCV (🟢)
(ten vines in each of five rows)

201 🔴	211 🔴 🟢	221 🟢	231 🟢	241
202 🔴 🟢	212	222 🔴 🟢	232 🟢	242
203 🔴	213	223 🟢	233	243 🟢
204 🔴	214	224 🟢	234 🟢	244 🔴 🟢
205 🔴	215 🔴	225 🟢	235 🔴	245 🔴
206 🔴	216 🔴	226 🟢	236 🔴	246 🟢
207	217 🔴	227 🟢	237 🔴	247
208	218 🔴 🟢	228 🟢	238	248
209 🔴	219 🟢	229 🟢	239 🔴	249
210 🔴	220 🟢	230 🟢	240	250

Rooting cuttings of selected virus-infected cultivars in the greenhouse



Rooting cuttings of selected virus-infected cultivars in the greenhouse



As of March 1, 2020

Questions to be investigated

Within vineyards in 2020

What is the impact of virus infection (individually and in combination) on the accumulation of Brix, pH, and titratable acids at harvest in Norton, Chardone1 and Vignoles?

What is the impact of virus infection (individually and in combination) on soluble sugars in leaves?

What is the concentration of virus in leaves

Planning for future studies

We plan to establish vines infected with different combinations of viruses at a single location, which will be essential for examining the long term impact of the viruses on vine health and berry quality.

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