

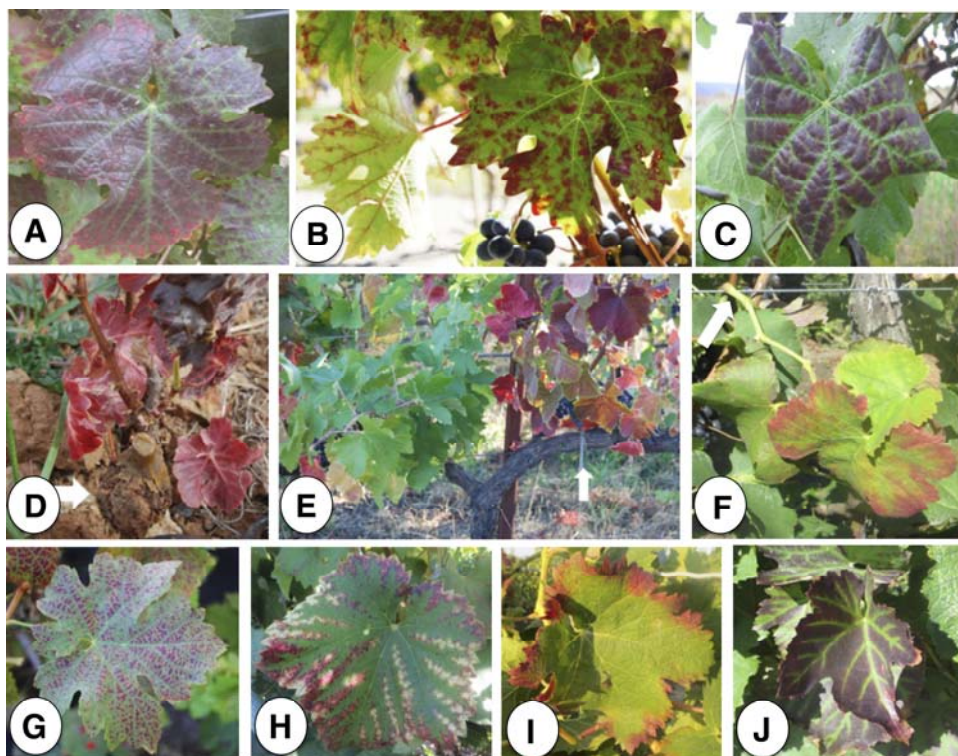
# How Grapevine Physiology is Affected by Grapevine Red Blotch Associated Virus

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# Grapevine Red Blotch Associated Virus (GRBaV)

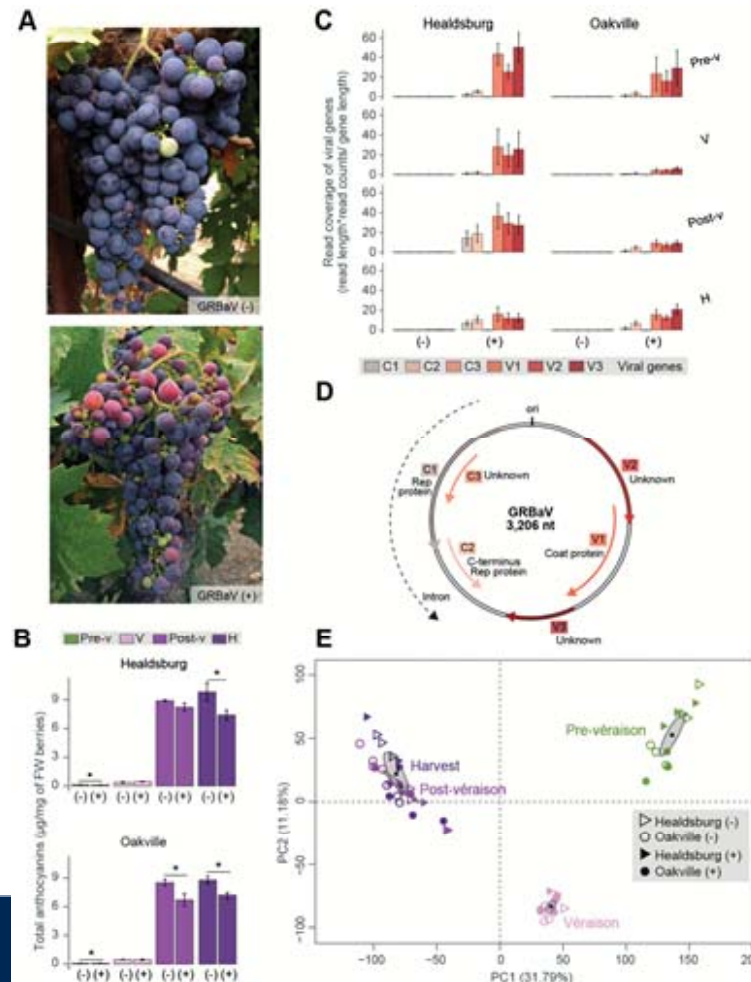
- Discovered in 2008
- A circular ssDNA virus with resemblance to geminiviruses
- Incidence and severity
  - Grape cultivar
  - Environmental conditions
  - Cultural practices
- Affects on berry physiology well documented
- Lack of knowledge on:
  - Mineral nutrition, plant physiology linked to berry chemistry

# Not all discolorations are the same!



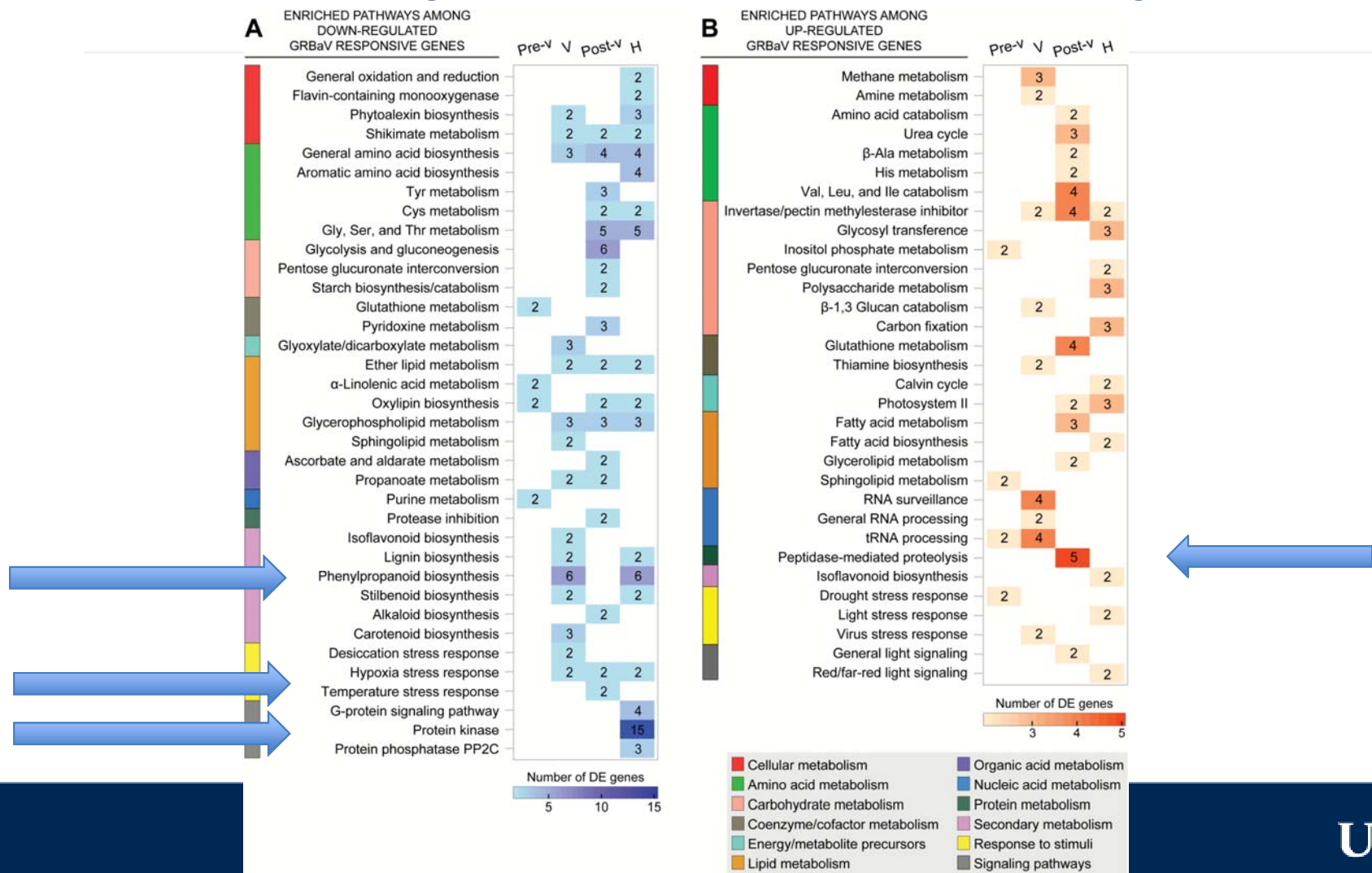
**Fig. 4.** Biotic and abiotic factors associated with leaf reddening and foliar symptoms in grapevine. **A**, Grapevine red blotch-associated virus on Cabernet Franc; **B**, *Grapevine leafroll-associated virus 3* on Cabernet Franc; **C**, *Grapevine leafroll-associated virus 1* on Pinot noir; **D**, Crown gall on Barbera (arrow points to the tumor); **E**, cordon of a Syrah vine constricted by a tied plastic twine (arrow points to the twine); **F**, broken shoot of a Tempranillo (arrow points to the point of physical injury); **G**, mite damage on Cabernet Franc; and nutritional disorders on **H**, Sangiovese; **I**, Grenache, and **J**, Cabernet Franc.

# Asynchronous berry ripening response at harvest



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# Down and up-regulated GRBaV responsive genes



# Experiment set-up

- UC Davis Oakville Experiment Station
- 24 year-old Cabernet Sauvignon #7/110R
- NE-SW orientation, 6' x 9' spacing
- Grapevines identified as symptomatic vs. healthy in 2015
- Grapevines qPCR tested for GRBaV and Leafroll disease in 2016 at UC Davis FPS
- Completely randomized design
  - Four replications
  - Six GRBaV (-), Six GRBaV (+), free of other virus infections



Objective: Does the effect of GRBaV on primary metabolism affect berry composition and secondary metabolism?

## Materials and methods

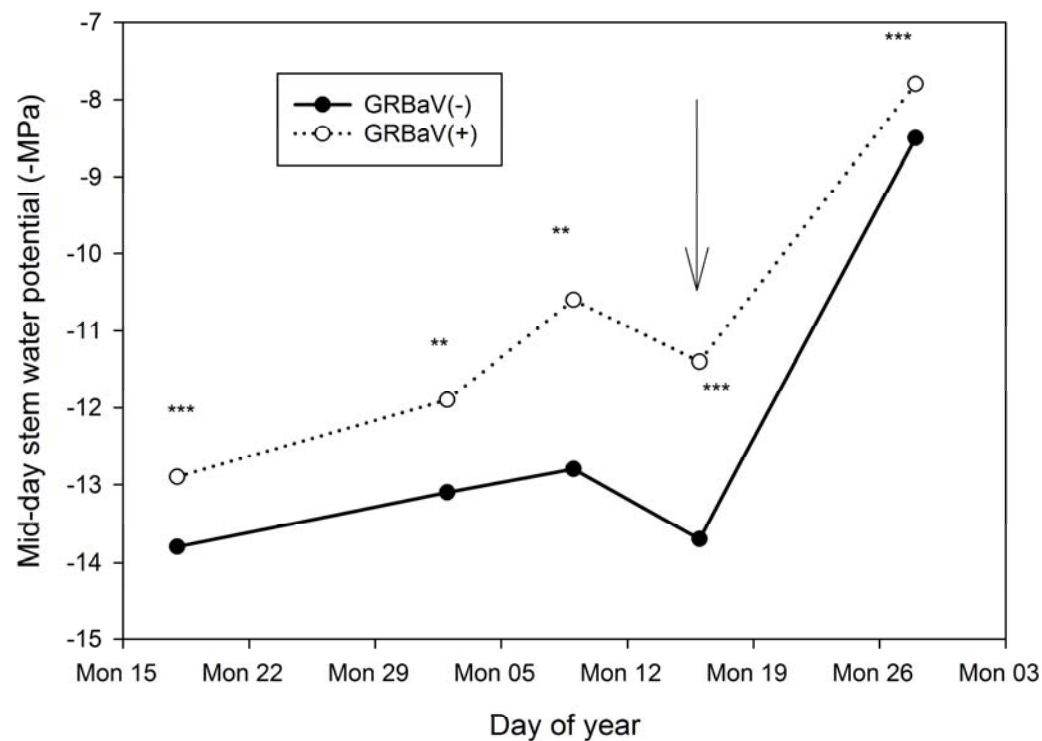
- Mid-day stem water potential
- Net gas exchange
- Components of yield
- Virus progression ratings
- Leaf sugars \*
- Berry skin flavonoid assessment
- Pruning mass \*





# RESULTS

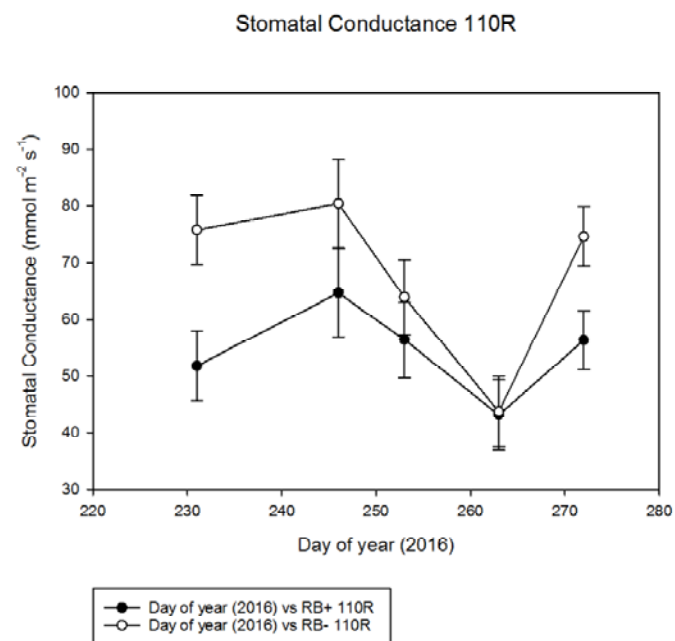
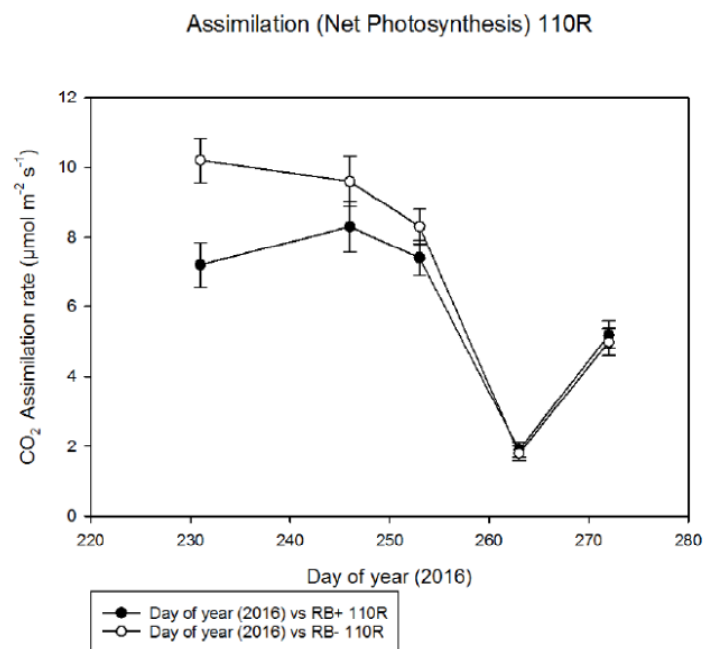
# Effects of GRBaV on mid-day stem water potential



## Effects of GRBaV on macronutrient content of petioles at bloom

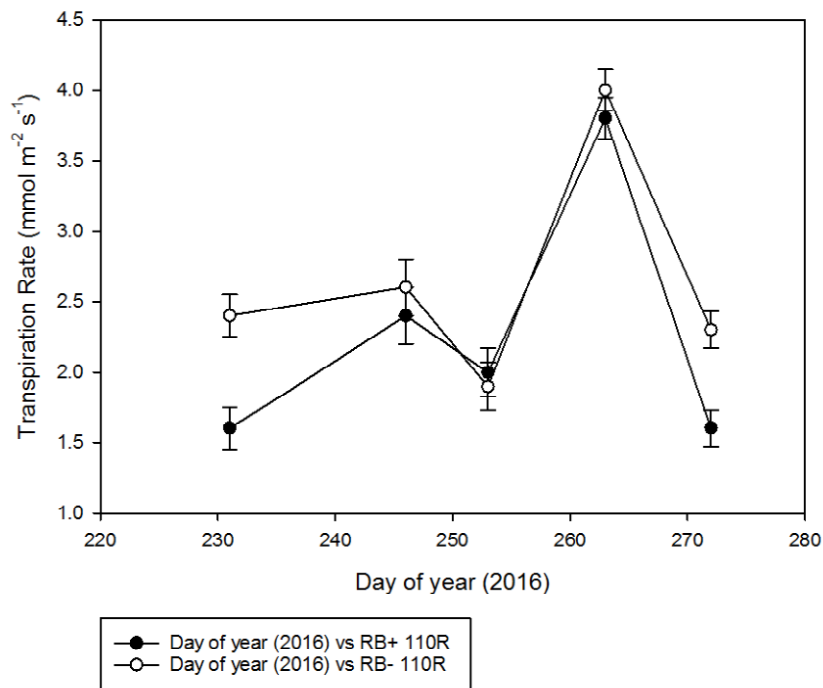
Virus status	Total N (%)	Total P (%)	Total K (%)	Total Ca (%)	Total Mg(%)	Total S (ppm)
GRBaV (-)	1.85	0.25 b	1.91	2.33 a	1.45	2110
GRBaV (+)	1.77	0.45 a	2.01	2.07 b	1.25	1921
Pr>F	0.4868	0.0003	0.7164	0.0038	0.0532	0.2473

# Net gas carbon assimilation and stomatal conductance

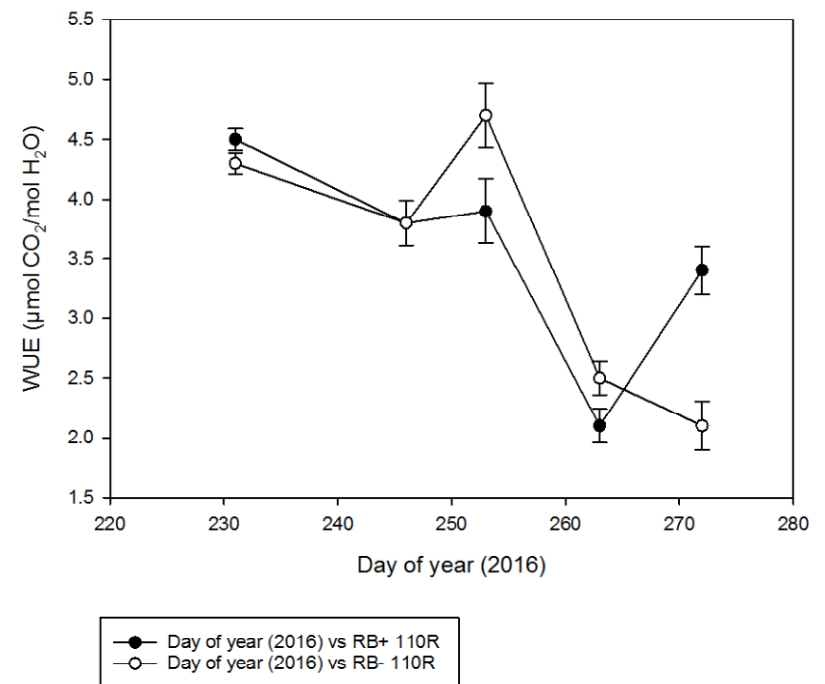


# Effects of GRBaV on transpiration and intrinsic water use efficiency

Transpiration Rate 110R



Water Use Efficiency 110R



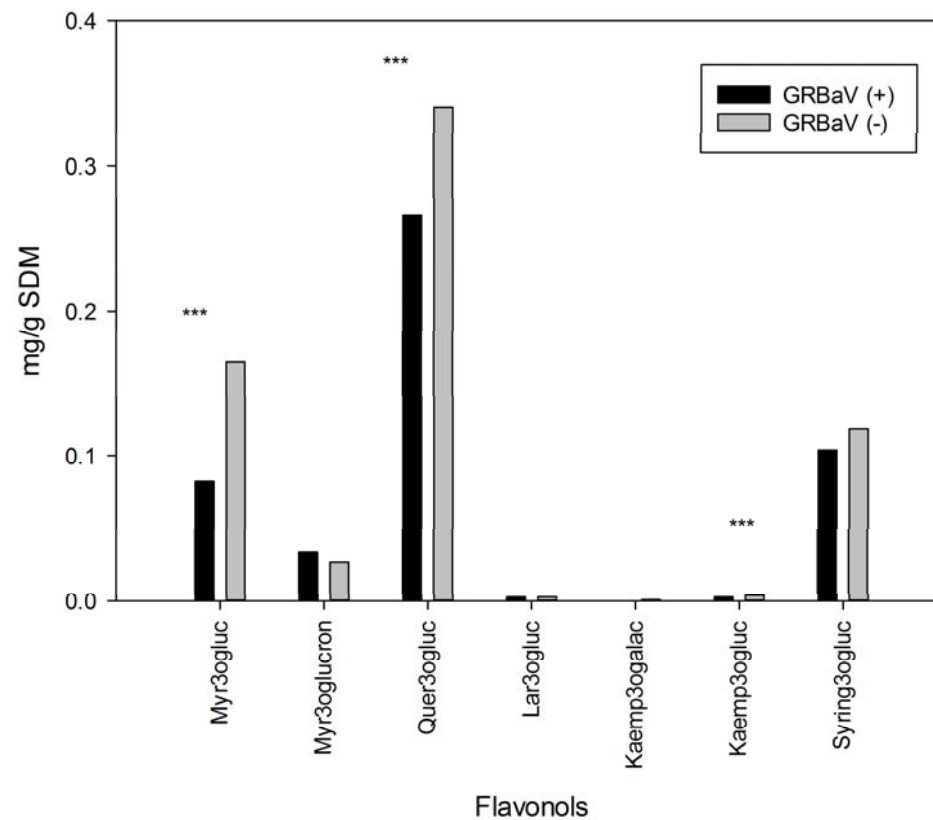
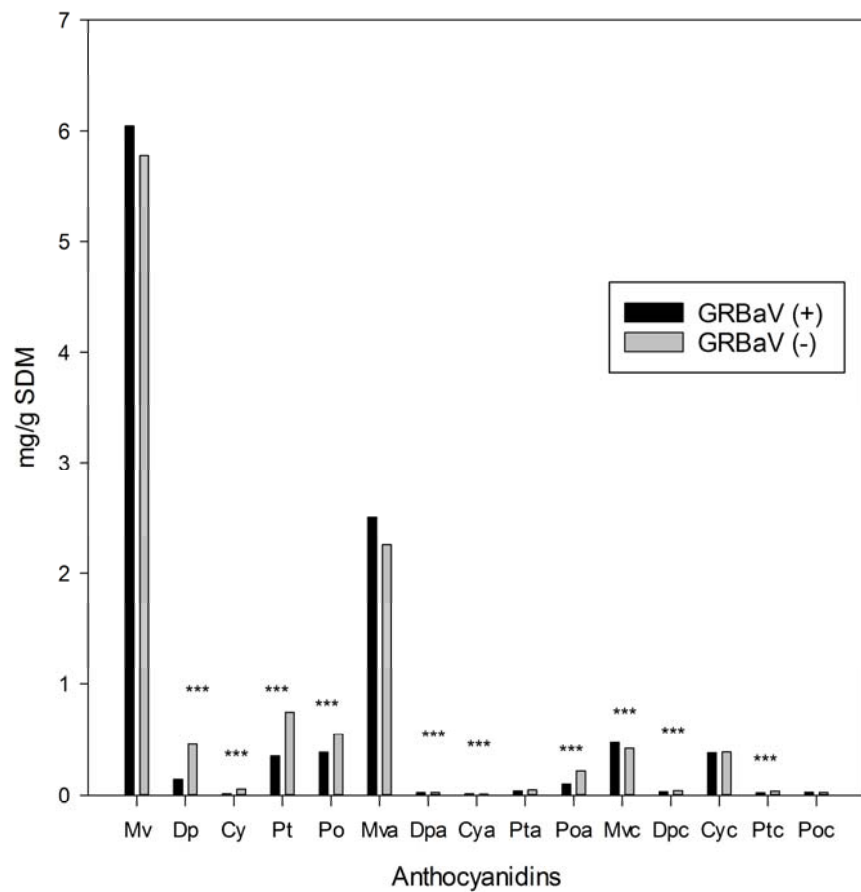
## Effect of GRBaV on components of yield

Virus status	Cluster wt (kg)	Clusters/vine	Yield (kg/vine)
GRBaV (-)	0.13	36	4.6
GRBaV (+)	0.13	42	5.1
Pr>F	0.86	0.13	0.26

## Effect of GRBaV on berry composition at harvest

Virus status	Berry mass (g)	Brix	Juice pH	TA
GRBaV (-)	1.14	27.0 a	3.75	5.85 b
GRBaV (+)	1.03	22.1 b	3.68	7.15 a
Pr>F	0.8600	0.0001	0.1680	0.0025

## Effects of GRBaV on berry anthocyanin and flavonol content



# Discussion

- Genotypic data Cantu lab GRBaV (+) grapevine
  - Down regulation of:
    - Glycolysis, gluconeogenesis
    - Phenylpropanoid
    - Protein kinase
    - Amino acids
- Phenotypic data from Kurtural lab GRBaV (+) grapevine:
  - Downregulation of:
    - Net C assimilation (40%)
    - Net transpiration (40%)
    - Six carbon sugar accumulation (20%)
    - Anthocyanin accumulation (20%)

## Take home messages

- Reduction in primary metabolism is under transcriptional control
  - A 40% reduction in primary metabolism (net C exchange, transpiration) provided evidence:
    - 20% reduction in Brix accumulation
    - 20% reduction in flavonoid accumulation
  - Grapevine seemingly stuck in juvenile phase
    - Greater P content in petiole at bloom provided further evidence with reduced net C exchange
    - Reduced Ca content potentially related to decreased stomatal conductance

Thank you

