

‘Norton’ Grapevine is Resistant to Grapevine Vein Clearing Virus

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Virus Resistance in Grapevines

- ❖ Identification of resistance genes to viruses in *Vitis* rarely reported
- ❖ Resistance to viruses highly desirable trait

GVCV

- ❖ DNA virus endemic to our area

- ❖ Vein-clearing, stunted vine, death of infected vine

- ❖ Deformed berries



GVCV



- ❖ Native grapevines host the virus $\approx 10\%$ (19/186)
- ❖ Discovered *A. cordata* as viral reservoir $\approx 34\%$ (142/413)
- ❖ Found grape aphids (*A. illinoisensis*) are a vector

GVCV



❖ Native
grapevines

V. cinerea

V. vulpina

V. rupestris

V. palmata

❖ Cultivated
grapevines

Chardonel

Vidal blanc

Cabernet Sauvignon

Traminette

Chardonnay

Valvin Muscat

**What
about
Norton?**




The Wonders of Norton

Resistant to:

- ❖ Downy mildew
- ❖ Powdery mildew
- ❖ Bunch rot



Norton and GVCV



**Grape
Foundation
Vineyard**

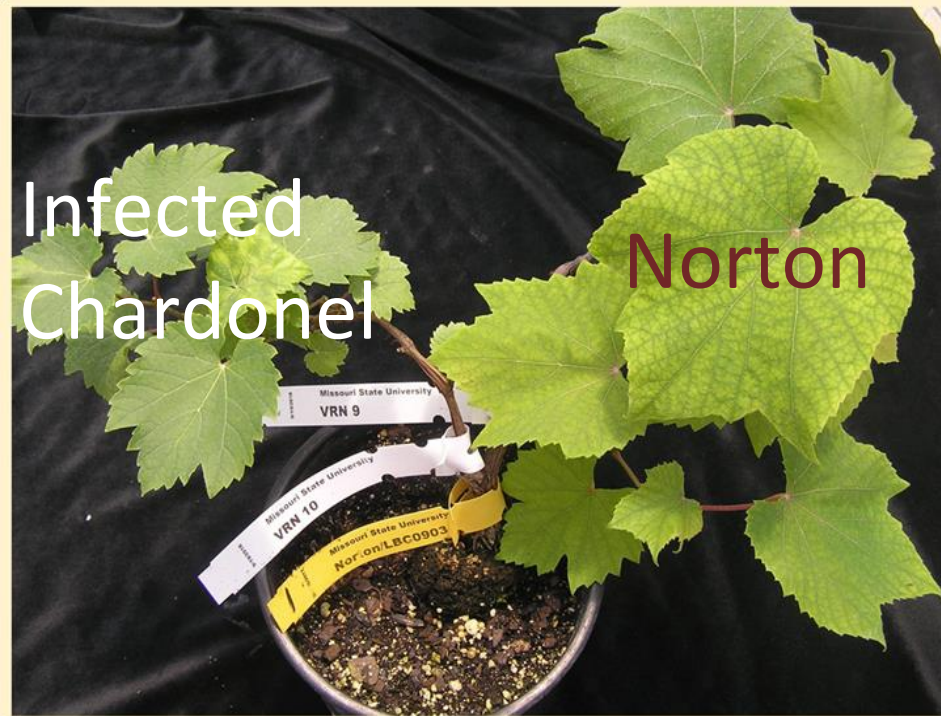

Missouri State
MOUNTAIN GROVE

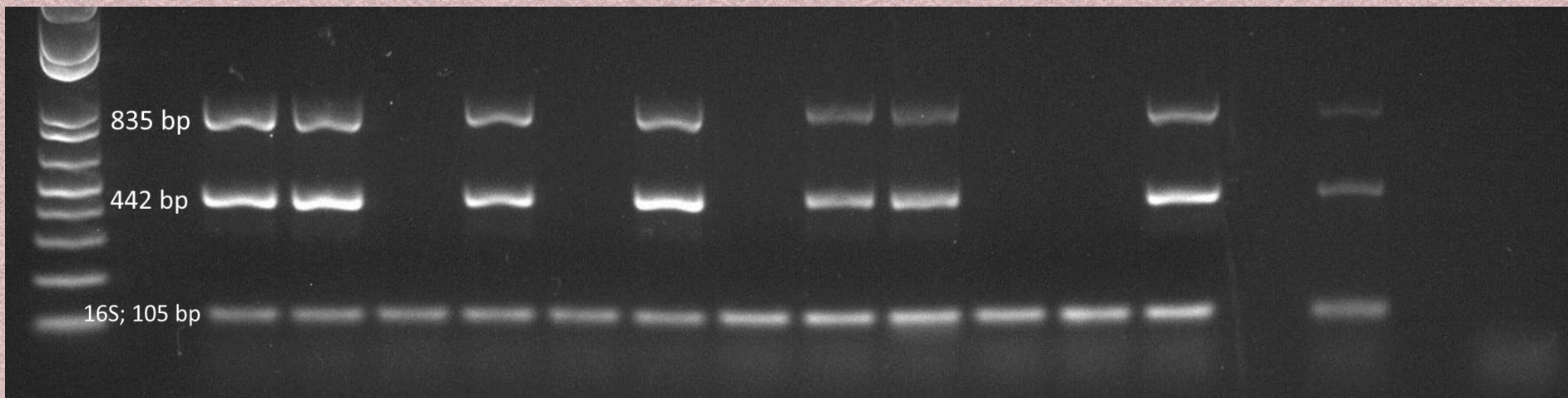
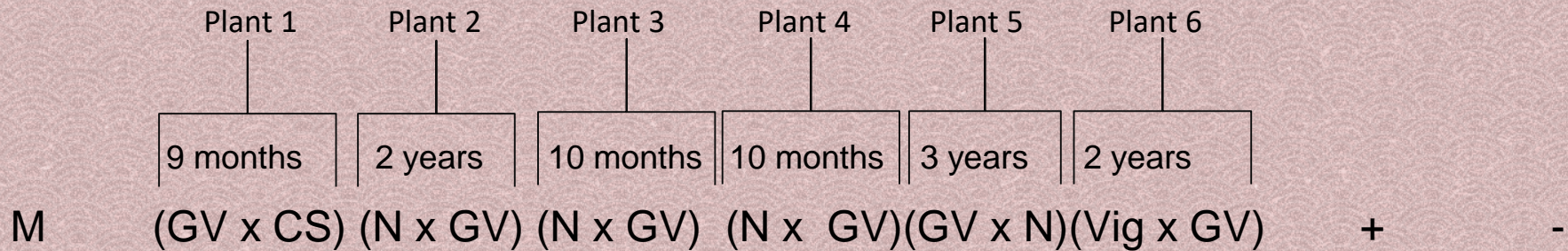
**Survey of
GVCV in
Foundation
Vineyard**

	Chardonel	Vidal Blanc	Norton
Total	19%	30%	0

Norton scion on GVCV-
infected Chardoneel

GVCV-infected
Chardoneel on Norton





GVCV-specific 442 bp and 835 bp fragments by PCR.

The 16S rRNA-specific 105 bp fragment baseline for DNA quality.

CS-‘Cabernet sauvignon’, GV-GVCV infected ‘Chardonel’, N-‘Norton’, Vig-‘Vignoles’ (scion x rootstock).

RNA for a DNA virus?

- ❖ Required part of GVCV replication cycle
- ❖ Part of plant defense against viruses

RNAseq

- ❖ Next-generation technology that determines sequence and quantity of all RNA present in plant sample
- ❖ We used RNAseq to determine presence of GVCV

RNAseq scions and rootstocks

GV x CS

GVCV genome 100% assembled from small RNAs in **GVCV-infected Chardonel scion** and **Cabernet Sauvignon**

N x GV

GVCV genome not assembled from Norton scion. GVCV genome 100% assembled from **GVCV-infected Chardonel**

GV x N

GVCV genome 100% assembled from **GVCV-infected Chardonel scion**. GVCV genome not assembled from Norton

**Norton
as
parent**

Norton



**Cabernet
sauvignon**



**Resistant
progeny?**

**Quality wine
grapes?**

Norton as parent

- ❖ **2006- Planted 100 crosses of Norton and Cabernet Sauvignon**



**Norton
as
parent**

- ❖ **2019-Pathogen
resistance
experiments on
progeny**

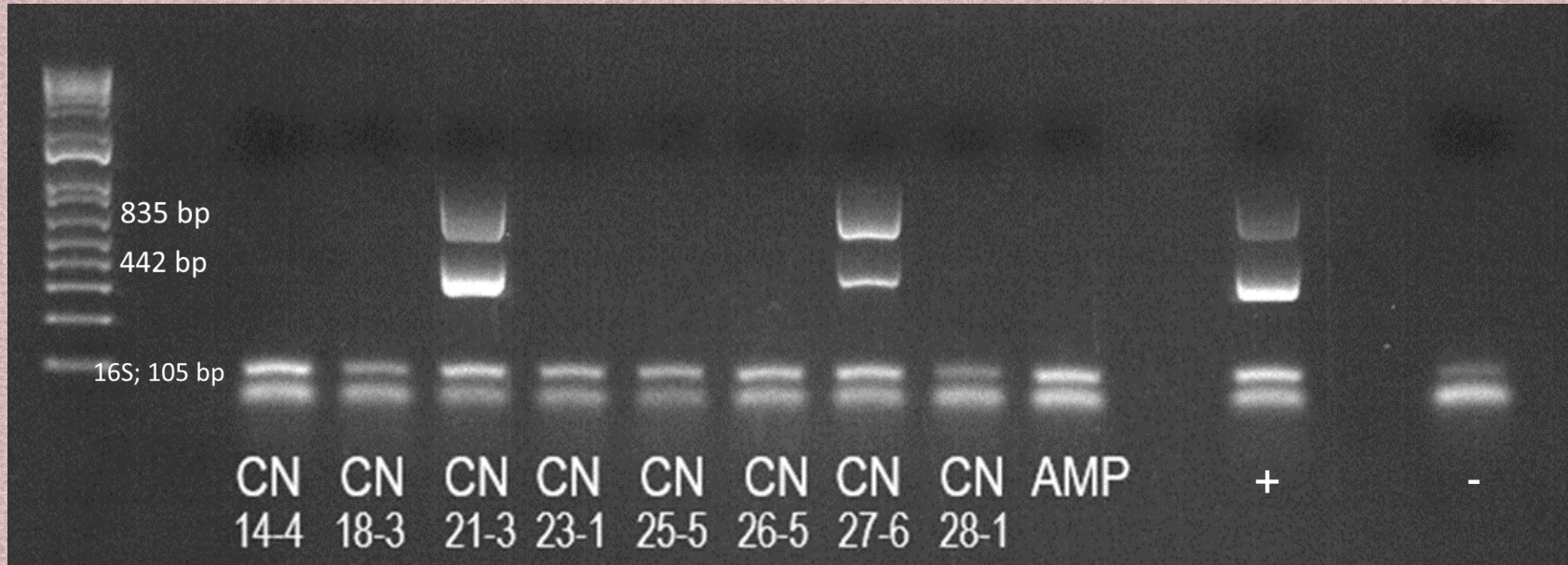


Norton as a parent

- ❖ Over 200 grafts of progeny and GVCV-infected Chardoneel
- ❖ Surviving vines assayed
- ❖ 61 progeny susceptible to GVCV via graft transmission
- ❖ 20 resistant



PCR assay of Norton progeny grafted with GVCV infected Chardone



GVCV-specific 442 bp and 835 bp fragments by PCR
The 16S rRNA-specific 105 bp fragment baseline for DNA quality
CN; Cabernet Sauvignon mother crossed with Norton

Management of viruses



Prevention

- ❖ Virus free planting stock
- ❖ Limit vectors
- ❖ Control inoculum sources

Management of viruses

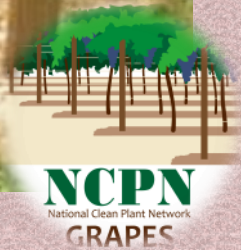


❖ Resistance to grapevine viruses

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*Photo: Wendy McFadden,
(OMAFRA)*

Norton
Vignoles
Chambourcin
Chardonel
Vidal Blanc
Traminette
Cayuga White
Vivant
Orion
NC-6



Conclusion

- ❖ Norton is resistant to GVCV
- ❖ Evidence via field studies, grafting, PCR and RNAseq
- ❖ Preliminary progeny evaluation shows resistance likely a heritable trait from Norton

Future research

- ❖ Investigate whether Norton is resistant or tolerant to other important grapevine viruses

Future research

- ❖ Explore breeding to confer virus resistance to progeny
- ❖ Discern mechanism(s) of Norton's resistance



**THANK
YOU!**

