Viticultural Performance of Chardonel Grapevines is Altered By Grapevine Vein Clearing Virus and Vine Decline Disease

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Abstract

Grapevine Vein Clearing Virus and Vine Decline Disease is a serious problem in vineyards in the Midwest and Upper South. In 2009, a new virus was identified from symptomatic vines and found to be associated with the disease. This virus, Grapevine Vein Clearing Virus (GVCV), was the first DNA virus discovered in grapevines.

GVCV testing was conducted in a Chardonel vineyard located near Rocheport, MO. This enabled the establishment of a population of vines which tested positive and negative for GVCV. These vines were monitored for viticultural performance during the 2009-2011 seasons. Yield and vegetative growth were reduced in vines testing positive for GVCV. Basic fruit composition (percentage soluble solids, pH, and titratable acidity) was generally not negatively impacted in vines with GVCV. Vine mortality increased over time in vines with GVCV. Practical aspects of management of GVCV in the vineyard will be discussed.

Leaves of Chardonel grapevines that tested positive for GVCV showing symptoms of vein clearing, mottling and deformation.

Introduction

Over 70 virus and virus-like agents have been identified in grapevines; most of them are RNA viruses. Grapevine vein clearing virus (GVCV) is a new DNA virus, the first DNA virus discovered in grapevine. It is a new virus species in the *Badnavirus genus, Caulimoviridae family.* GVCV is closely associated with the vein-clearing symptom. It remains to be determined if GVCV is the causal agent of the disease.

Grapevine vein clearing and vine decline disease is becoming a serious problem in vineyards in the Midwest and Upper South. This disease was first observed in regional vineyards over 30 years ago, but was misidentified as a disease caused by *Grapevine fanleaf virus (GFLV)* based on observations and the analytical methods of the period. A comprehensive investigation of the disease and associated pathogens was started in 2004. Through grafting of affected buds onto healthy Chardonnay, Cabernet Franc and Baco Blanc vines, it was determined that agents are graft-transmissible. In the beginning, GFLV and *Tomato ringspot virus (ToRSV)* were considered candidate viruses. Extensive assays of GFLV and ToRSV in symptomatic leaves did not find a close association between these viruses and the disease. In 2009, next generation sequencing technology was applied in the screening of potential viruses in symptomatic vines and a new virus was found to be associated with the disease.

The objectives of this study were to compare yield, yield components, fruit composition and growth of Chardonel vines that were infected with GVCV to those without GVCV.

Prevention of Grapevine Virus Problems

1. Plant with virus-tested vines.
2. Control virus vectors.
3. Use sufficient fallow period before replanting.
4. Reduce alternative host plants within 300 feet of vineyard.
5. Rogue virus infected vines.

National Clean Plant Network (NCPN)

The National Clean Plant Network for Grapes is an association of clean plant centers, scientists, educators, state and federal regulators, and nurseries and growers from the wine, table, raisin and juice grape industry concerned with the health of grapevine budwood and rootstock.
It was established in 2008 and is part of the NCPN specialty crops network. The network operates under the umbrella of the United States Department of Agriculture (USDA).

Table 1.Effect of Grapevine Vein Clearing Virus(GVCV) and vine decline disease on yield and yield components of Chardonel grapevines.Rocheport, MO. 2008-2011.

Treatment	Yield (kg/vine)	Yield (MT/ha)	Clusters/ vine	Cluster weight (g)	Berry weight (g)	Berries/ cluster
-GVCV	6.7a [z]	13.3 a	39	168.2 a	2.3 a	74.7 a
+GVCV	2.7b	5.3 b	23	116.4 b	1.6 b	72.5 b
	0.0228	0.024	NS [y]	0.0042	0.0006	NS

[z] Means followed by the same letter do not differ significantly at the 0.05 level. Least Square Means separation by LSMeans Differences Student's T Test
[y]Not significant

Table 2.Effect of Grapevine Vein Clearing Virus (GVCV) and vine decline disease on fruit composition of Chardonel grapevines.Rocheport, MO. 2008-2011.

Treatment	Soluble solids (%)	pH	Titratable acidity (g/L)[z]
-GVCV	21.9	3.27 b[y]	7.9 a
+GVCV	22.4	3.38 a	6.9 b
	NS[x]	0.0058	0.0047

[z]Expressed as tartaric acid
[y] Means followed by the same letter do not differ significantly at the 0.05 level. Least Square Means separation by LSMeans Differences Student's T Test
[x]Not significant

Table 3.Effect of Grapevine Vein Clearing Virus (GVCV) and vine decline disease on vegetative growth of Chardonel grapevines.Rocheport, MO. 2008-2011.

Treatment	Shoots/ vine	Pruning weight (kg/vine)	Nodes retained/ vine
-GVCV	26	0.66 a[z]	33 a
+GVCV	17	0.23 b	19 b
	NS[y]	0.045	0.0421

[z] Means followed by the same letter do not differ significantly at the 0.05 level. Least Square Means separation by LSMeans Differences Student's T Test
[y]Not significant

Materials and Methods

1. The experimental plot was located in a commercial 'Chardonel' vineyard near Rocheport, MO.

2. Vines were planted in 1998 and trained to a vertically-shoot-positioned (VSP) trellis/training system.

3. Vineyard spacing was 1.83 x 2.74 meters (vine x row).

4. The vineyard soil type was Menfro Silt Loam and vines were drip irrigated.

5. Vines were balance pruned to retain 20 nodes per 454g of cane prunings with an upper limit of 45 nodes per vine. Vines with less than 454g of cane prunings had 20 nodes retained.

6. All other cultural practices were conducted by the commercial vineyard staff.

7. Selection of vines for the experiment:

a) In 2008, populations of asymptomatic and symptomatic vines were established by visual inspection.

b) A subset of the asymptomatic and symptomatic vine populations were tested for Grapevine Vein Clearing Virus (GVCV) by RT-PCR in 2011. Fifteen vines classified as symptomatic were selected for testing. Two vines were dead; eleven of the remaining thirteen vines tested positive for GVCV; and two of the thirteen vines were negative for the presence of GVCV. In addition, six asymptomatic vines were selected for testing and all of these vines were negative for the presence of GVCV.

c) Vines positive and negative for GVCV were also tested for a panel of grapevine viruses by RT-PCR and qRT-PCR in 2011 (GLRaV 1-5 and 7-10,-2RG, -Carnelian, GVA, GVB, GVD, GVE, RSPaV and GFkV , and Xylella fastidiosa by qRT-PCR; GLRaV 6 and 11 by RT-PCR; GAMaV, GVFV, and RSPaV-PN by RT-PCR; and ToRSV and GFLV by both RT-PCR and qRT-PCR). Vines testing negative for the panel of viruses were included in this experiment.

8. Treatments were a) vines testing negative for GVCV, testing negative for other grapevine viruses/diseases, and exhibiting no visible symptoms of GVCV and b) vines testing positive for GVCV, testing negative for other grapevine viruses/diseases, and exhibiting visible symptoms of GVCV.

9. Data collected were: Yield and yield components; fruit composition; and vegetative growth.

10. Data were analyzed using JMP statistical software(version 9.4; SAS Institute; Cary, NC).

Conclusions

1. The presence of GVCV in vines resulted in reduced yield. Yield reduction was primarily due to lower cluster and berry weight.

2. Basic fruit composition was impacted to a limited extent in this experiment. In general, fruit maturity was advanced in vines with GVCV. This result was likely due to differences in yield.

3. Vines testing positive for GVCV had less vegetative growth as indicated by dormant pruning weight.

4. More research is needed on GVCV (distribution, identification of vectors, cultivar susceptibility, etc.).

Literature Cited

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