Vine performance in site infested with *Xiphinema index* nematode

UCCE Sonoma County Grape Day
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Plant parasitic nematodes
Non-segmented, microscopic roundworms

X. index:

Vector of grapevine fanleaf virus, the causal agent of grapevine fanleaf disease

- Virus is bound to esophagus lining in *X. index*
- Virus particles are lost at molt, do not pass through egg stage
- do not replicate inside nematode

Xiphinema index

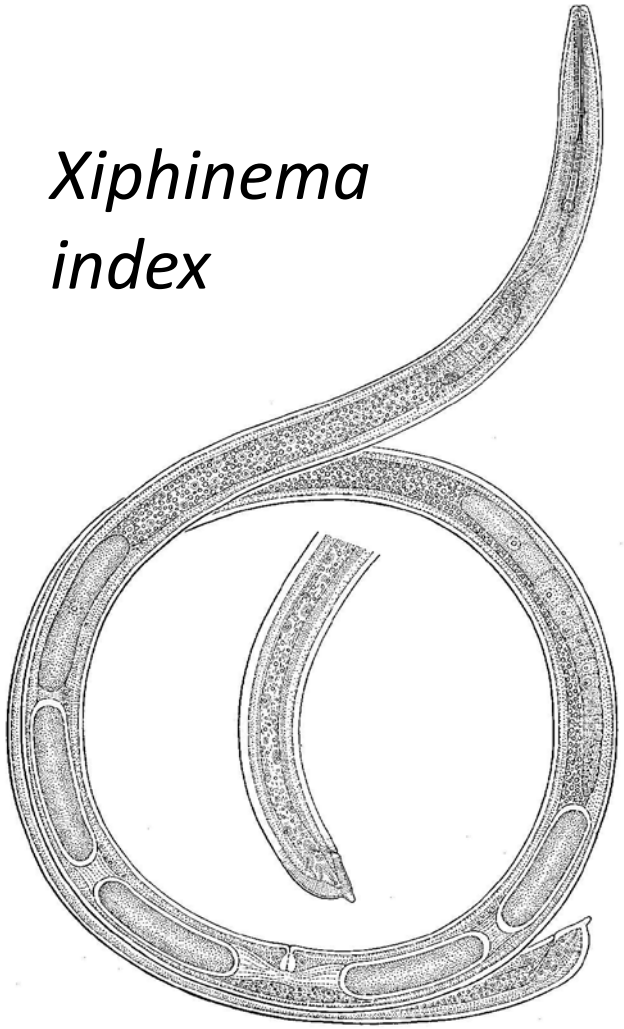


Image: courtesy of H. Ferris

Reduced fruit set

Yellow mosaic leaf symptoms in the spring

Vein banding

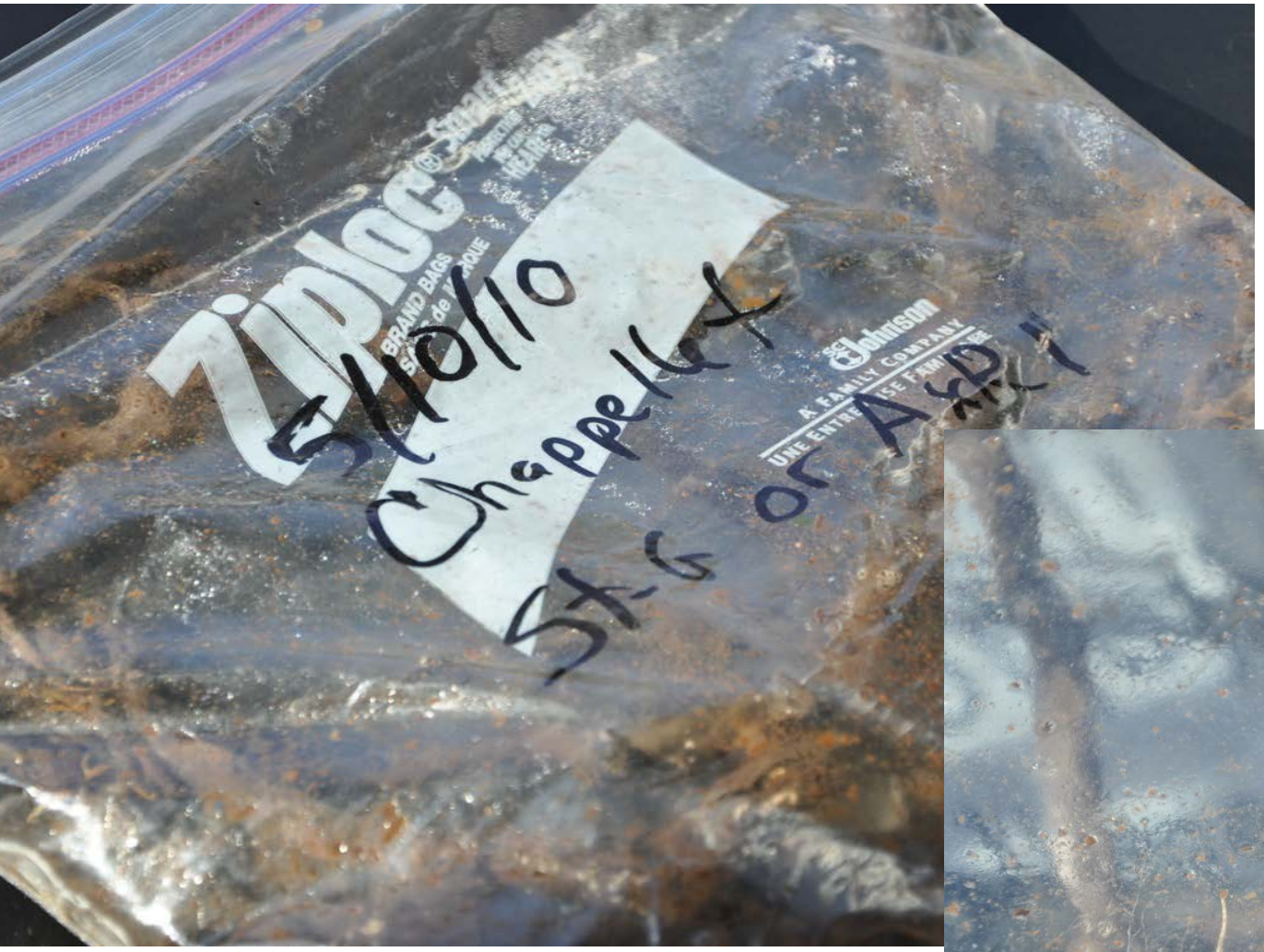
Yellow mosaic

Fan-shaped leaf blades

Canes of vine infected with grapevine fanleaf virus showing abnormal branching

Once a vineyard has fanleaf degeneration, it will always be diseased and crop will be reduced each year

- When diseased vines are pulled, remaining roots provide a reservoir for the virus
- Complete decay of remnant roots is thought to take many years and *X. index* can survive on those roots
- When the site is replanted, the new vines will become infected and eventually show disease symptoms



Six years in old rocky terraces without top-growth and 60 days in the bag

Photos: Andrew Walker

Untarped Telone application prior to replanting a vineyard

Photo: Larry Bettiga, Monterey County

Cabernet Sauvignon on 110R, planted 1985

Napa County UCCE Trial:

Can we kill grapevine roots with herbicide application as an alternative to fumigation?

Treatments applied 26-Oct 2009

6 replicates, 5 vines per replicate

Triclopyr (Garlon)
Glyphosate (Roundup)

- **Cut and Paint**: cut vine to ~6 inches with chainsaw and immediately apply 2 ml herbicide
- **Drill and Inject**: drill 6 inch hole in head of vine and fill with dilute herbicide
- **EZ-Ject**: 2 shells per vine
- **Hack and Squirt**: use hatchet to make 2 cuts in vine trunk; apply 1 ml herbicide to each cut

Slide source: John Roncoroni

Dr. Brad Hanson, UCCE Weed Science Specialist, UC Davis

Slide source: John Roncoroni

GRN Rootstocks

	Root lesion Nematode	Citrus Nematode	Ring Nematode	Phylloxera Nodosities
GRN-1	**MR**	**R**	**R**	**HR**
GRN-2	**MR**	**MS**	**MS**	**HR**
GRN-3	**MR**	**MR**	**MR**	**R**
GRN-4	**MR**	**MR**	**MR**	**R**
GRN-5	**MR**	**MR**	**R**	**MS**

HR
Highly Resistant

R
Resistant

MR
Moderately Resistant

MS
Moderately Susceptible

All GRN rootstocks are resistant to *Xiphenema index,* 3 strains of root-knot nematodes, these combined, and at high soil temperatures.

Ferris, Zheng and Walker. 2012. Journal of Nematology 4(4)

	GRN Rootstock Parentage
GRN1	*V. rupestris* x *V. rotundifolia* 'Cowart'
GRN2	(*V. rufotomentosa* x (Dog Ridge x Riparia Gloire)) x Riparia Gloire
GRN3	(*V. rufotomentosa* x (Dog Ridge x Riparia Gloire)) x *V. champinii* c9038
GRN4	(*V. rufotomentosa* x (Dog Ridge x Riparia Gloire)) x *V. champinii* c9038
GRN5	(Ramsey x Riparia Gloire) x *V. champinii* c9021


RS 3
GRN 2
August 2018


GRN 2

GRN 1


O39-16

Rootstock Trial in Cabernet Sauvignon

Site:	South end of Geyserville
Planted:	2012
Soil:	Yolo loam
Spacing:	10 ft x 7 ft
Trellis:	Modified vertical shoot positioned
Training:	Bi-lateral cordon trained, spur pruned
Design:	Randomized complete block, 8 replications of 11 rootstocks using 5-vine plots

Rootstock Trial, Alexander Valley; 2017 imagery with overlay of trial design

XXXXX

One 5-vine plot

Data collected from 3 vines in each plot.

Collecting soil for nematode samples

December 2018

Number of plots out of 8 that contained nematodes by rootstock

Rootstock	*X. index (dagger)*	*M. xenoplax* (ring)	X. americanum (dagger)
GRN 1	3	1	6
GRN 2	0	6	0
GRN 3	2	6	1
GRN 4	1	6	0
GRN 5	0	6	0
O39-16	2	0	7
RS 3	8	8	5
RS 9	4	1	2
Schwarzmann	0	7	3
1616C	7	2	6
1103P	6	6	4

GRN 1

Counts: *Xiphinema index,* December 2018*

						2				
									2	
				1						

*Three soil sub-samples per plot were combined into a single sample. Results reported on 100% extraction from 250 cc/sample.

GRN 1 - GRN 2 - GRN 3 - GRN 4 - GRN 5 - O39-16

Counts: *Xiphinema index,* December 2018*

4					3					
		4		6		2				
									2	
									2	
				1						

*Three soil sub-samples per plot were combined into a single sample. Results reported on 100% extraction from 250 cc/sample.

GRN 1 - GRN 2 - GRN 3 - GRN 4 - GRN 5 - O39-16

Counts: Ring nematode (*Mesocriconema xenoplax*), Dec. 2018*

208					108		96			
8				6			12			100
104		280					8	296		
	12	4	236		4					
	16		4		12		4			
	64			16			4			
			92						16	
								4		

*Three soil sub-samples per plot were combined into a single sample. Results reported on 100% extraction from 250 cc/sample.

RS 3 - RS 9 - Schwarzmann - 1616C - 1103P

Counts: *Xiphinema index,* December 2018*

	162							18		
	20		8						56	
	18		3	14	22					
				34		7		46		
3						12		104		11
		10			16	8				44
	6							28		2
18				40						

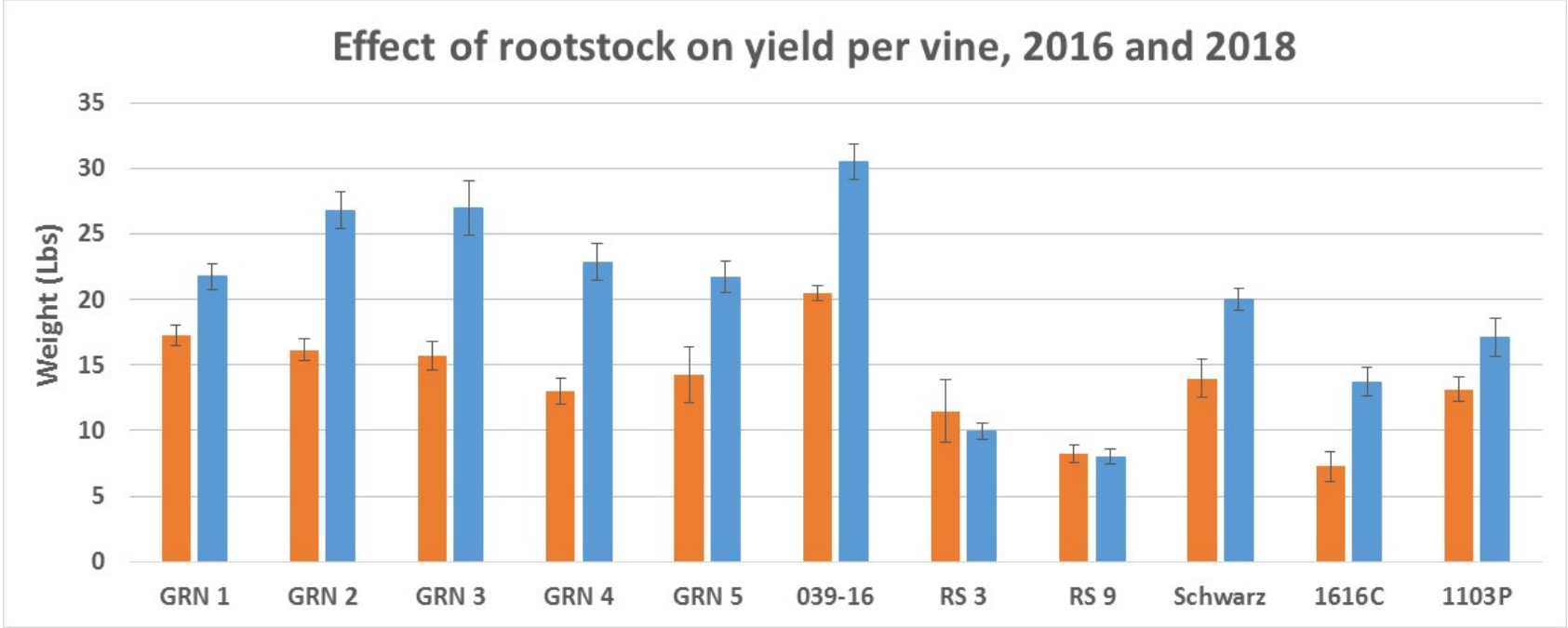
*Three soil sub-samples per plot were combined into a single sample. Results reported on 100% extraction from 250 cc/sample.

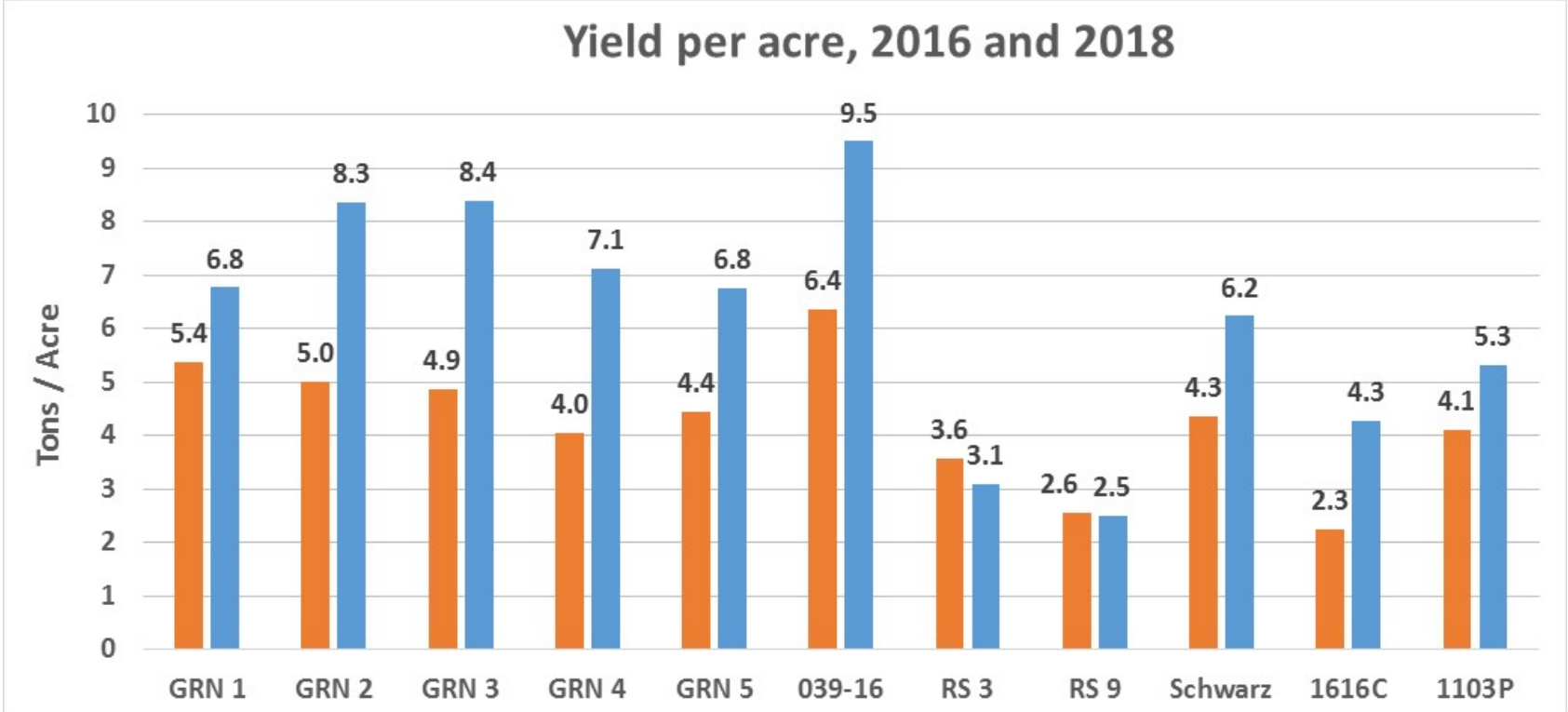
RS 3 - RS 9 – Schwarzmann - 1616C - 1103P

Counts: Ring nematode (*Mesocriconema xenoplax*), Dec. 2018*

	116							24		
	4							320	66	
	112		88	4		50				
				16		52				8
				26		390		8		
12					4	10				
12	6									4
96				20						84

*Three soil sub-samples per plot were combined into a single sample. Results reported on 100% extraction from 250 cc/sample.


Effect of rootstock on yield per vine, 2016 and 2018
Weight (Lbs)
35
30
25
20
15
10
5
0
GRN 1
GRN 2
GRN 3
GRN 4
GRN 5
039-16
RS 3
RS 9
Schwarz
1616C
1103P


Yield per acre, 2016 and 2018
Tons / Acre
10
9
8
7
6
5
4
3
2
1
0
5.4
6.8
5.0
8.3
4.9
8.4
4.0
7.1
4.4
6.8
6.4
9.5
3.6
3.1
2.6
2.5
4.3
6.2
2.3
4.3
4.1
5.3
GRN 1
GRN 2
GRN 3
GRN 4
GRN 5
039-16
RS 3
RS 9
Schwarz
1616C
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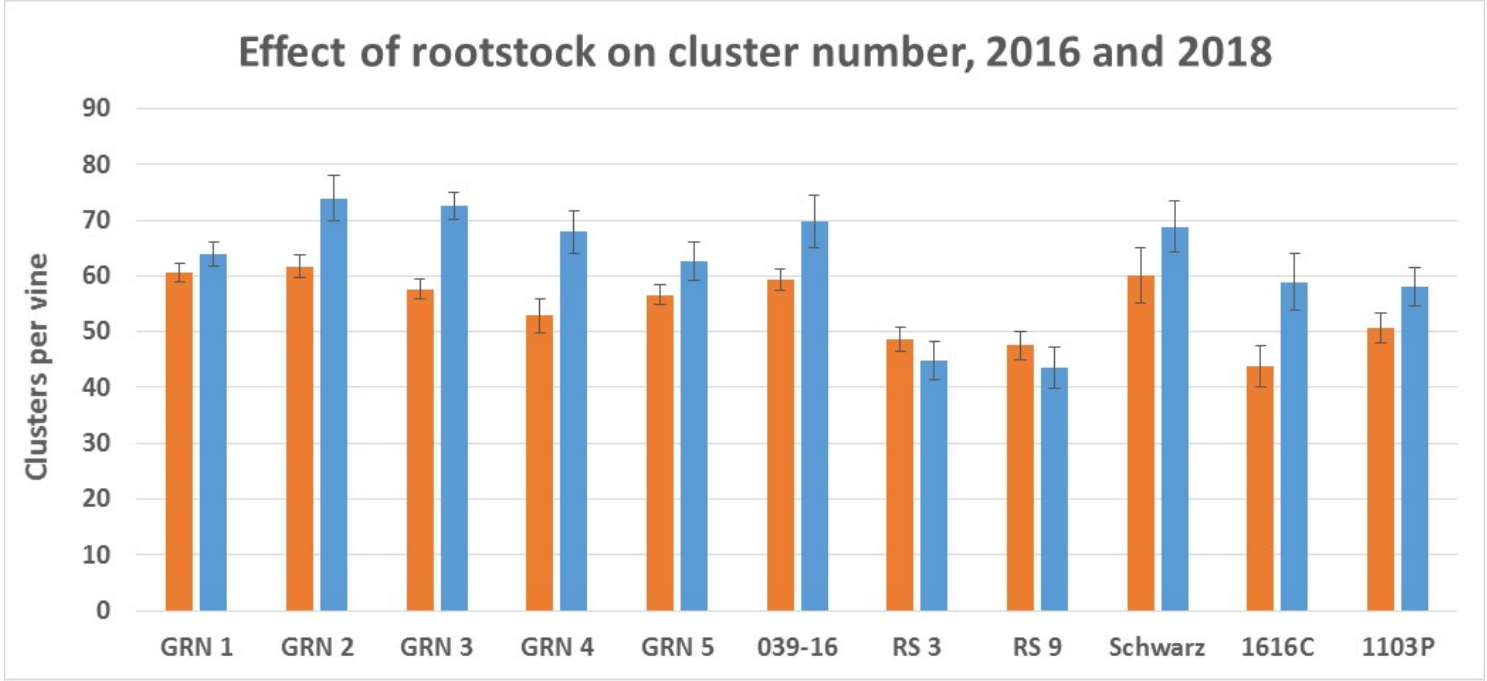
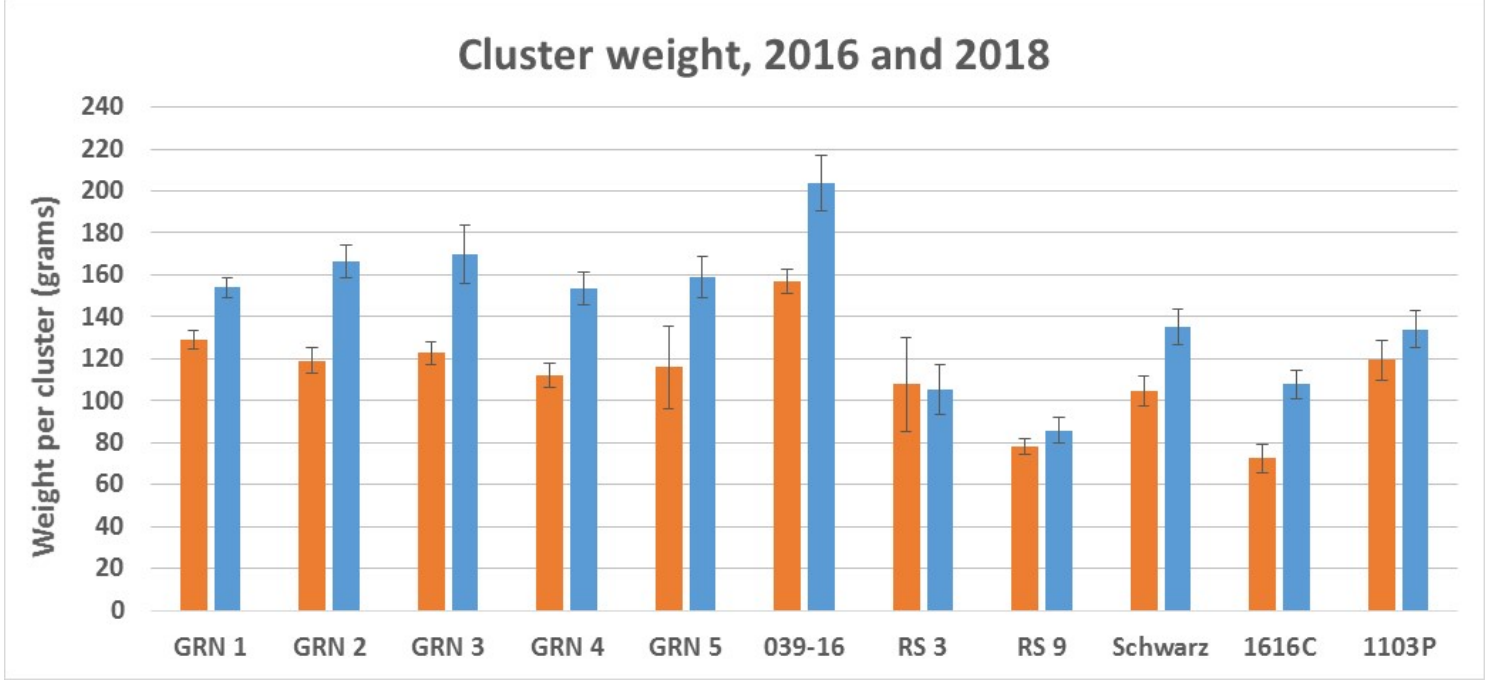
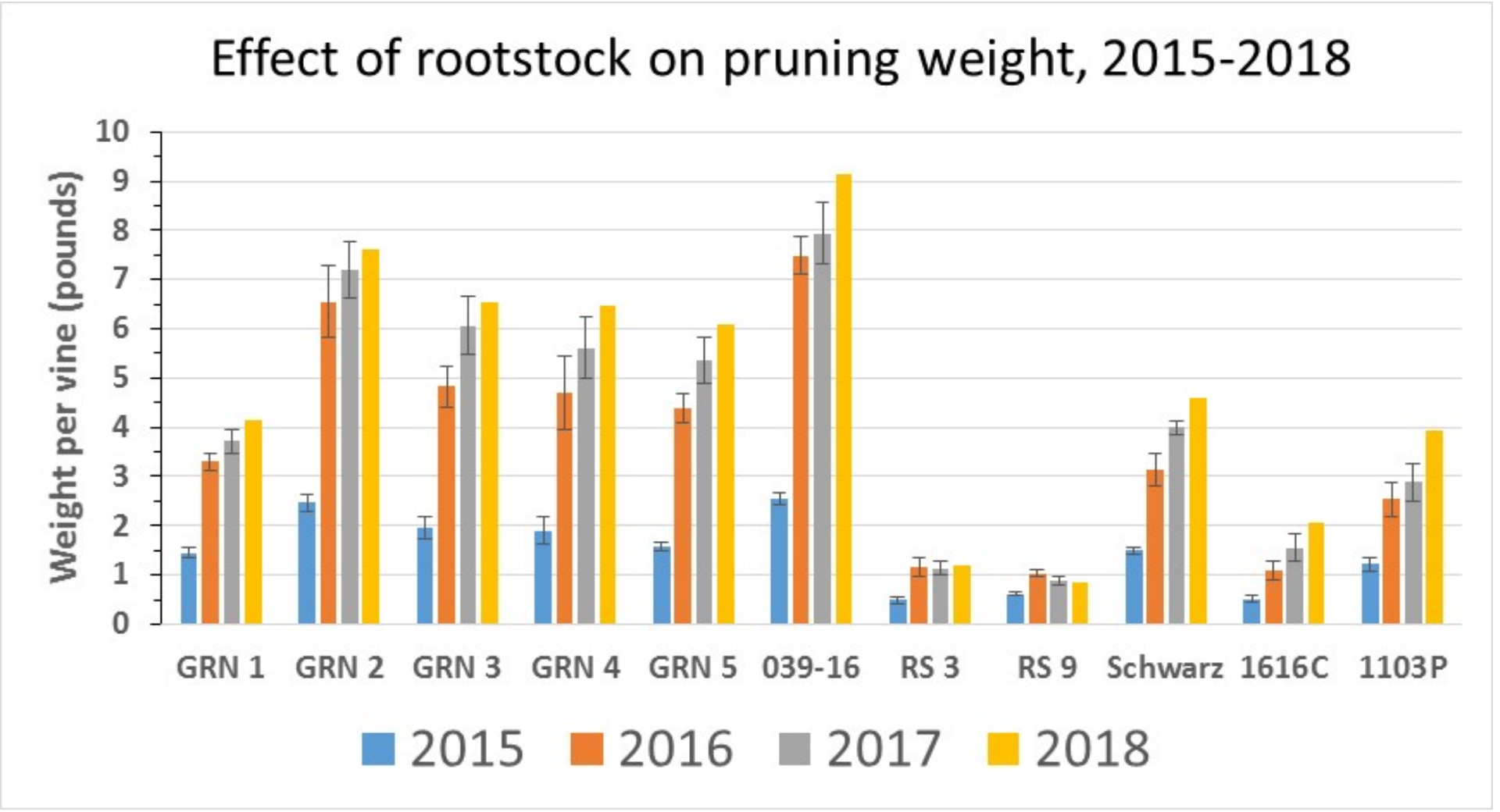
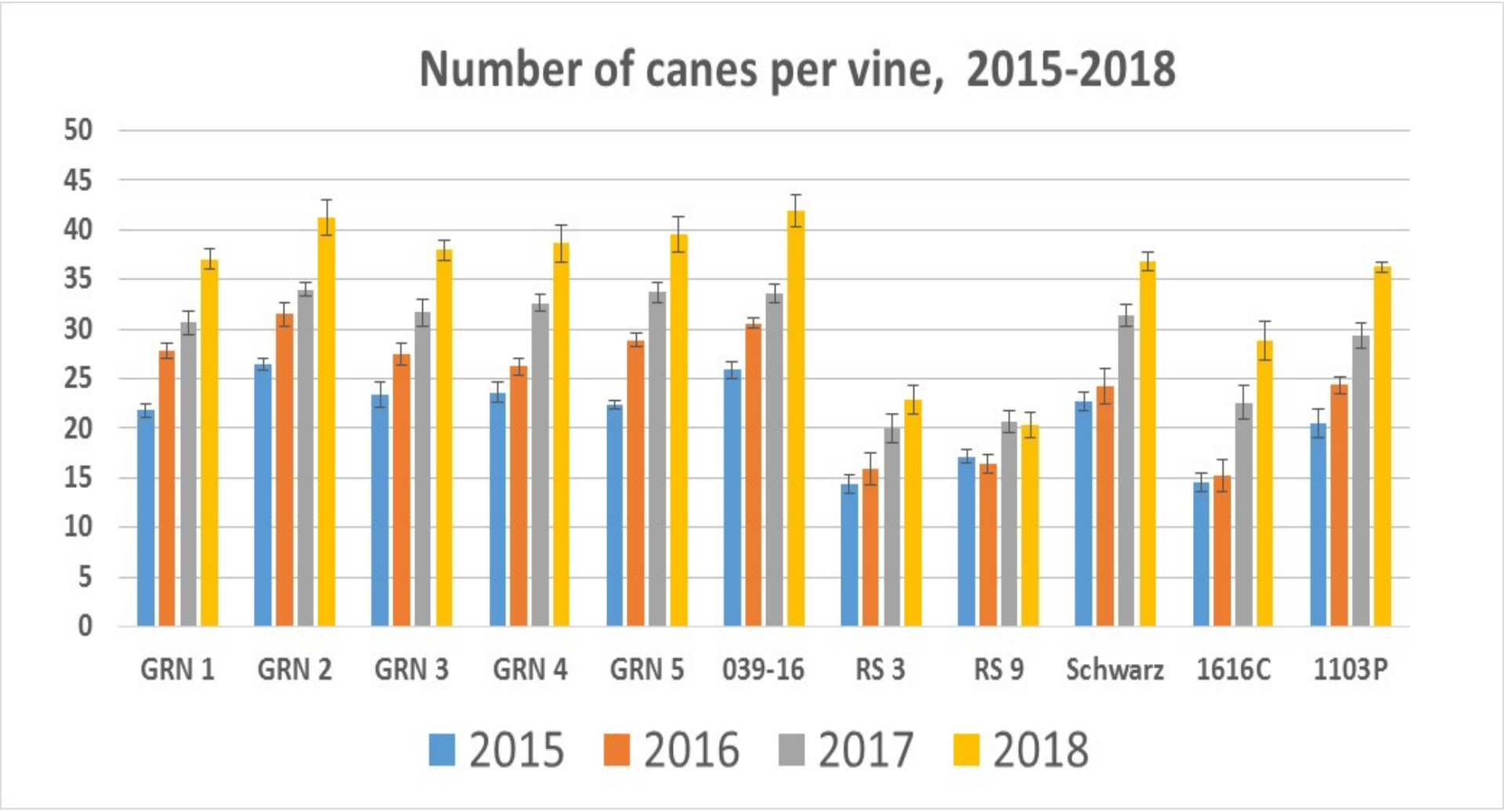

Effect of rootstock on cluster number, 2016 and 2018
Clusters per vine
90
80
70
60
50
40
30
20
10
0
GRN 1
GRN 2
GRN 3
GRN 4
GRN 5
039-16
RS 3
RS 9
Schwarz
1616C
1103P


Cluster weight, 2016 and 2018
Weight per cluster (grams)
240
220
200
180
160
140
120
100
80
60
40
20
0
GRN 1
GRN 2
GRN 3
GRN 4
GRN 5
039-16
RS 3
RS 9
Schwarz
1616C
1103P


O39-16
RS 9

Pruning weights are collected from three vines in each plot


Effect of rootstock on pruning weight, 2015-2018
Weight per vine (pounds)
0
1
2
3
4
5
6
7
8
9
10
GRN 1
GRN 2
GRN 3
GRN 4
GRN 5
039-16
RS 3
RS 9
Schwarz
1616C
1103P
2015
2016
2017
2018


Number of canes per vine, 2015-2018
50
45
40
35
30
25
20
15
10
5
0
GRN 1
GRN 2
GRN 3
GRN 4
GRN 5
039-16
RS 3
RS 9
Schwarz
1616C
1103P
2015
2016
2017
2018

Grapevine fanleaf virus infection status determined with ELISA test; 2017 and 2018

GFLV-negative GFLV-positive GFLV-marginal

GRN 3			GRN 1	GRN 5	GRN 4		GRN 2			O39-16
GRN 2		O39-16		GRN 3		GRN 1	GRN 5			GRN 4
GRN 4		GRN 3					GRN 1	GRN 5	O36-16	GRN 2
GRN 1	GRN 2	GRN 3	GRN 4		GRN 5		O39-16			
	GRN 5	039-16	GRN 4		GRN 2		GRN 3		GRN 1	
	GRN 5	039-16		GRN 2			GRN 4	GRN 3	GRN 1	
			GRN 2	GRN 1	O39-16	GRN 3	GRN 4		GRN 5	
	GRN 5	039-16	GRN 1		GRN 2			GRN 3	GRN 4	

2017: In each plot, two shoot tips per vine were collected and a single composite sample was tested.

2018: Shoot tips were collected and all GRN and O39-16 vines were tested separately. Plots in red had one or more GFLV-positive vines.

Results from the 2018 virus testing and nematode sampling in the 48 plots which contain GRN and O39-16 rootstocks

- 25 plots of the GRN and O39-16 rootstocks tested negative for grapevine fanleaf virus (GFLV)
- 23 plots tested positive for GFLV (an increase of 6 from 2017)
- *X. index* was found in 8 plots

- There is a large variability in population density within a block and between adjacent vines.
- When redeveloping a vineyard, collect nematode samples to determine the relative abundance and types of nematodes present to inform your rootstock selection.


Thank you