Agriculture and Natural Resources

Grape Rootstocks for Southwest Texas: Interpretation for Real County

Travis Helm, County Extension Agent-Agriculture & Natural Resources
Texas A&M AgriLife Extension Service

Extension Specialists: Mark Black, Extension Plant Pathologist, Uvalde; James Kamas, Extension Horticulturist, Fredericksburg; David Appel, Extension Plant Pathologist, College Station

Summary

The warm-climate bacterium *Xylella fastidiosa* subsp. *fastidiosa* causes Pierce's disease (PD), a vascular disease of wine and table grapes. The endemic bacteria are moved from plant to plant by several xylem-feeding insects including glassy-winged sharpshooter (GWSS, *Homalodisca vitripennis*). European wine grape varieties are highly susceptible and stress (drought, fruit load) accelerates symptom development and vine death.

The warm-climate fungus *Phymatotrichopsis omnivora* causes cotton root rot (CRR) of grape and over 2,000 other plant species. The fungus survives in high pH soils found in two-thirds of Texas. Own-rooted European wine grape varieties and many hybrid rootstocks are susceptible and are also unable to absorb sufficient iron (Fe) and other nutrients from calcareous high pH soils that predominate in Southwest Texas. The stress of heavy fruit load accelerates vine death.

Crown gall (CG), caused by the bacterium *Agrobacterium vitis*, may occur in wine grapes after a winter freeze event. The bacterium is commonly systemic in nursery stock. A hard freeze can wound vines and trigger galling and vine die-back. Incomplete winter dormancy and excessive soil moisture in winter are predisposing factors.

Objective

Rank grape rootstocks for survival from diseases and high pH thin soil in Southwest Texas

Materials and Methods

Monitor replicated trials of selected grafted rootstocks

We have rootstock comparison data from four sites in 2012: **A,** PD-tolerant scion varieties grafted on PD-tolerant rootstocks (Leakey, thin soil on fractured limestone, planted 28-29Apr11, own-rooted scions as controls, five-plant plots, five replications, drip irrigation, small wood pruned back to two buds), **B,** similar experiment with Florilush instead of Tampa (Uvalde, planted 31May-1June12, no own-rooted controls, five-plant plots, three replications, furrow

irrigation), **C,** PD-susceptible 'Sangiovese' on selected rootstocks (Leakey, planted 27Sep11, ten-plant plots, five replications, drip irrigation, small wood left up to cordon wire when pruned in 2012), and **D,** same experiment (Stonewall, planted 20-21Sep1). Data collected were nutrient deficiency symptoms, relative growth rates, or mortality and cause.

Tests **A** and **C** were not treated with imidacloprid. Test **B** received imidacloprid by drench soon after transplanting. Test **D** was not treated, but some nearby grapes received imidacloprid.

Results and Discussion

Typical symptoms of PD were not observed in any experiment at the Leakey site. Test **C** (Leakey) leaf composites within plots were all negative for *X. fastidiosa* serology (ELISA). Glassy-winged sharpshooter, the presumed most common vector of *X. fastidiosa*, was present at the site in 2012 based on sightings in the experimental vineyard and catches on yellow sticky traps (Table 1).

Table 1. Adult glassy-winged sharpshooter (*Homalodisca vitripennis*) counts on yellow sticky traps placed on three dates in 2012 in or near the experimental vineyard near Leakey, Texas.

		Individuals/trap		
Location	**No. traps**	**mid-May-12**	**18-Jul-12**	**31-Aug-12**
North row of vineyard	3	0.75	3.67	1.67
West fence >50 ft from a vine	3	0.33	3.00	1.00
South fence >400 ft from a vine	1	1.00	1.00	0.00

A, PD-tolerant scion varieties grafted on PD-tolerant rootstocks, Leakey. Across rootstocks on 22June, Blanc du Bois had less growth than the other two scions while Black Spanish had more mature leaves with nutrient deficiency symptoms (Table 3). Across scions on 22June, own-rooted and Tampa had the least growth, while Tampa, own-rooted, and Kober 5BB had more mature leaves with deficiency symptoms. There was a significant interaction between scion and rootstock and growth was best for Chambourcin/Dog Ridge and Black Spanish/1103P. There were highly significant differences among replications, indicating the variable soil at the site.

Across rootstocks on 20Sept, Blanc du Bois and Black Spanish had more growth than Chambourcin, but many Chambourcin plants were chip budded early in 2012 and growth is expected to be similar in the future (Table 4). Across scions on 20Sept, Kober 5BB and Paulsen 1103 had more growth than other rootstocks. The three scions had similar overall deficiency symptoms and cotton root rot mortality. Dog Ridge, Paulsen 1103, and Kober 5BB had the least deficiency symptoms and cotton root rot mortality among rootstocks. Own rooted and Tampa treatments had the most cotton root rot.

Leaf petiole samples (late June, older mature leaves with deficiency symptoms, young mature asymptomatic leaves) and soil samples (late July, replications 1, 5) revealed very low petiole and

soil phosphorus levels at this site. Deficiency symptoms were consistent with rare reports of P deficiency in grape. Because phosphorus is important for root growth, uptake of other minerals (K, Mg) was probably also limited. Iron (Fe) was supplemented by soil and foliar spray.

B, PD-tolerant scion varieties grafted on PD-tolerant rootstocks, Uvalde. Across rootstocks on 20August, Blanc du Bois was intermediate for growth compared to more vigorous Chambourcin and slower growing Black Spanish (Table 5). Black Spanish had the most mature leaves with nutrient deficiency symptoms. Across scions on 20August, 5BB and 1103P had the most growth, and Florilush uniformly induced Fe deficiency symptoms.

Data analysis did not take into account later planting dates for certain plots, especially Black Spanish/Dog Ridge,, so growth estimates for that treatments are artificially low. Vine growth was good on this deep high pH soil site. Chambourcin is highly susceptible to powdery mildew (caused by the fungus *Erisiphe necator* [*Uncinula necator*]), but Blanc du Bois and Black Spanish are resistant (Table 2).

C, PD-susceptible 'Sangiovese' on selected rootstocks, Leakey. On 18July, the most growth was on 5BB, Dog Ridge, Salt Creek, GRN-1, and 5C rootstocks (Table 6). Own-rooted had the least growth. Percent mature leaves with deficiency symptoms (presumed P deficiency) was least on Dog Ridge and 5C, and greatest on GRN-2, GRN-4, and own-rooted. Fe deficiency symptoms were most frequent on GRN-3, GRN-2, and GRN-1.

This experiment did not receive Fe by soil or foliar spray.

D, PD-susceptible 'Sangiovese' on selected rootstocks, Stonewall. (Table 7)

Table 2. Observations of powdery mildew and cotton root rot at Leakey and Uvalde, 2011-12.

Disease or problem	More susceptible	Less susceptible
Powdery mildew	Chardonnay, Merlot, Cabernet Sauvignon, Sangiovese, Chambourcin	Blanc du Bois, Black Spanish
Cotton root rot	Tampa, own-rooted *V. vinifera* varieties	Paulsen 1103
Iron deficiency[a]	Tampa, Florilush	Paulsen 1103

[a]Reduced iron (Fe) uptake in rootstock varieties due to calcareous soil with high pH (8.2 to 8.3).

Table 3. Relative vine growth and nutrient deficiency symptoms in mature grape leaves in Pierce's Disease tolerant varieties grafted on selected rootstocks near Leakey (Real County), Texas, 22June2012.

Scion	Total stem length above cordon, ft.[a]		Deficient mature leaves,%[b]	
BlackSpanish	3.7	a	77	b
BlancduBois	2.5	b	68	a
Chambourcin	3.4	a	63	a
P>F	<0.01		<0.0001	
Rootstock				
5BB	4.9	a	74	c

DogRidge		4.8	a	65	b
Own		0.7	b	73	c
1103P		4.7	a	53	a
Tampa		1.0	b	80	c
P>F		<0.0001		<0.0001	
Rep					
1		4.2	a	62	a
2		4.1	ab	66	ab
3		2.8	c	70	b
4		1.8	d	78	c
5		3.5	abc	70	b
6		3.0	bc	69	ab
P>F		<0.0001		0.0008	
Scion X	**Stock**				
Chambourcin	1103P	3.5	cd	43	a
BlancduBois	1103P	4.0	c	52	ab
BlancduBois	DogRidge	2.4	de	55	abc
Chambourcin	DogRidge	8.0	a	64	bcd
BlackSpanish	1103P	6.6	ab	65	cd
BlackSpanish	Own	1.3	efg	66	cd
Chambourcin	5BB	5.2	bc	67	cd
Chambourcin	Own	0.1	g	69	d
BlancduBois	5BB	3.8	c	70	d
Chambourcin	Tampa	0.3	fg	71	de
BlancduBois	Tampa	2.0	def	75	de
BlackSpanish	DogRidge	3.9	c	76	de
BlackSpanish	5BB	5.8	b	83	ef
BlancduBois	Own	0.6	fg	85	ef
BlackSpanish	Tampa	0.8	fg	93	f
P>F		<0.01		<0.0001	
CV, %		80		28	
Mean		3.3		70	

[a]Estimates excluded branching above cordon wire.
[b]Probably P deficiency more than K and Mg deficiencies.

Table 4. Relative vine growth, nutrient deficiency symptoms (mature, immature, defoliated), and cotton root rot incidence in Pierce's Disease tolerant varieties grafted on selected rootstocks or own-rooted near Leakey (Real County), Texas, 20Sept2012. Scion x rootstock interaction was not significant.

Scion	Total stem length above cordon, ft.[a]		Deficient leaves,%[b]	Cotton root rot incidence, %[c]
Blanc du Bois	6.4	a[d]	91	6
Chambourcin	4.8	b	92	9

Black Spanish	5.7	a	90		5	
P>F	0.0013		0.5	N.S.[e]	0.35	N.S.
Rootstock						
Kober 5BB	8.5	a	90	ab	5	ab
Dog Ridge	7.3	b	86	a	0	a
Own rooted	2.4	c	98	c	9	b
Paulsen 1103	8.2	ab	88	ab	0	a
Tampa	1.8	c	92	b	18	c
P>F	<.0001		<.0001		<.0001	
CV, %	64		17		341	
Mean	5.6		91		7.4	

[a]Estimates include stems that originated below the cordon wire, and excluded branching above cordon wire. Several vines have been replanted, but julian planting date covariate was not significant.

[b]Probably P deficiency more than K and Mg deficiencies. Several vines have been replanted, and julian planting date as a rootstock covariate (P>F <0.0001) explained more deficiency symptom variation than all other factors combined. Least squares means reflect an adjustment for planting date.

[c]Caused by the endemic soilborne fungus, *Phymatotrichum omnivora*.

[d]Means followed by the same letter are not different at P=0.05.

[e]Not significantly different at P=0.05.

Table 5. Condition of Pierce's disease tolerant grape scions[x] and rootstocks at Uvalde (Uvalde County), TX in first leaf on 20August2012.

Scion	**Relative growth, %**		**Deficient Mature Leaves, %[y]**	
Blanc du Bois	82	b[z]	16	a
Chambourcin	87	a	20	a
Black Spanish	76	c	24	b
P>F	<.0001		0.002	
Stock				
Kober 5BB	88	a	1	a
Paulsen 1103	85	ab	1	a
Dog Ridge	74	c	1	a
Florilush	81	b	77	b
P>F	<.0001		<.0001	
Rep				
1	85	a	19	
2	82	a	22	
3	78	b	19	
P>F	0.006		0.22	
Scion X	**Stock**			
Blanc du Bois	Kober 5BB	92 a	0.3	a
Chambourcin	Dog Ridge	91 a	0.7	a
Chambourcin	Paulsen 1103	87 ab	0.0	a

Black Spanish	Kober 5BB	87	ab	2.0	a
Black Spanish	Paulsen 1103	87	ab	2.7	a
Blanc du Bois	Florilush	86	ab	62.7	b
Chambourcin	Florilush	85	ab	77.3	c
Chambourcin	Kober 5BB	84	ab	0.3	a
Blanc du Bois	Paulsen 1103	80	b	1.0	a
Black Spanish	Florilush	71	c	90.3	d
Blanc du Bois	Dog Ridge	70	c	0.7	a
Black Spanish	Dog Ridge	60	d	2.0	a
P>F		<.0001		0.0005	
CV, %		15		61	
Mean		82		20	

[x]Own rooted scions in borders had relative growth and Fe deficient leaves of: Black Spanish (N=41) 73% and 39%; Chambourcin (N=2) 75% and 100%; Blanc du Bois (N=2) 68% and 100%.

[y]Fe deficiency symptoms.

[z]Means followed by the same letter were not significantly different at P=0.05.

Table 6. Relative 'Sangiovese' vine growth and nutrient deficiency symptoms in mature and immature grape leaves in Expanded Rootstock Experiment near Leakey (Real County), Texas, 18July2012.

Rootstock	**Total stem length above cordon, ft.**[a]		**Deficient mature leaves, %**[b]		**Deficient immature leaves, plant incidence**[c]	
Dog Ridge	10.4	ab	28.0	a	0.00	a
Teleki 5C	9.8	abc	32.1	ab	0.02	a
Kober 5BB	10.7	a	42.4	bc	0.00	a
GRN-1	9.9	abc	47.7	cd	0.21	b
Florilush	8.7	bcd	47.7	cd	0.10	a
Paulsen 1103	7.8	de	50.0	cd	0.00	a
GRN-3	8.5	cd	52.7	cd	0.82	d
Salt Creek (Ramsey)	10.1	abc	57.9	de	0.04	a
Own rooted	6.2	e	68.5	ef	0.08	a
GRN-4	7.6	de	70.9	f	0.02	a
GRN-2	7.9	de	73.9	f	0.52	c
P>f	<.0001		<.0001		<.0001	
Replication						
1	9.0		44.6	a	0.08	a
3	9.3		45.2	ab	0.27	b
2	8.3		52.9	bc	0.14	a
4	9.2		55.7	cd	0.10	a
5	8.5		61.4	d	0.24	b
	NS		<.0001		<.0001	
CV, %	50		57		160	
Mean	8.9		52		0.16	

[a]Estimate excluded branching above cordon wire.
[b]Probably P deficiency more than K and Mg deficiencies based on soil and petiole tissue testing.
[c]Probably Fe more than Zn deficiencies based on soil and petiole tissue testing.

Table 7. Relative 'Sangiovese' vine growth 23May12 and survival 6June12 (after freeze & crown gall) of the original transplants (20-21Sep11) in Expanded Rootstock Experiment near Stonewall (Gillespie County), Texas, 23May2012.

	23May2012		6June2012
Entry	Total stem length above cordon, ft.[a]	Original transplant survival[b]	Original transplant survival
GRN-1	4.5 ab	1.8 a	1.8 a
Dog Ridge	4.7 a	1.8 ab	1.7 a
Florilush	4.6 a	1.6 abc	1.6 ab
Teleki 5C	3.6 bcde	1.5 abc	1.2 cd
Salt Creek	3.8 abcd	1.5 abc	1.3 bc
GRN-4	4.2 abc	1.5 bc	1.2 cd
GRN-2	3.5 cde	1.4 cd	1.2 c
Kober 5BB	2.8 e	1.3 cd	1.1 cd
Paulsen 1103	2.9 de	1.3 cd	1.2 cd
GRN-3	2.8 e	1.1 de	0.9 de
Sangiovese ownrooted	1.4 f	0.9 e	0.8 e
CV	**52**	**48**	**67**
Mean	**3.5**	**1.4**	**1.3**
Pr>F	**<.0001**	**<.0001**	**<.0001**

[a]Estimates excluded branching above cordon wire.
[b]0=none of original plants survived, 1=original plants dying, 2=original plants thriving

Conclusions

1. Vines grafted on adapted rootstock(s) are essential for wine grape production in Southwest Texas.

2. Tampa and Florilush rootstocks should not be used in local soils (calcareous high pH).

3. Paulsen 1103 rootstock showed more promise than Kober 5BB and Dog Ridge. Paulsen 1103 has vigor, is tolerant of PD and cotton root rot, is able to take up iron (Fe) in high pH soils, and is available commercially as virus-tested nursery stock. Custom orders for PD-tolerant scions should be planned well in advance.

4. Nutrients in soil and leaf petioles must be monitored in thin/rocky calcareous clay soils of Southwest Texas and supplemented as indicated by laboratory tests and symptoms. Phosphorus deficiency may be an issue in poor calcareous soils in southwest Texas.

Acknowledgements

Alfred Sanchez, Liza Silva, B. J. Perez, Larry Stein and Rick Machen, Uvalde; Andrew Labay, Adam Elrod, Keisha Migura and Marvin Nebgen at Fredericksburg; Sheila McBride, College Station.

Cooperators: Frio Valley Vineyards, Leakey; Dustin Steubing and Trey Bader, Cedar Beetle Land Clearing, Inc., Leakey; Becker Vineyards, Stonewall