RESPONSES OF GROUND COVER PLANT SPECIES TO MECHANICAL INOCULATION WITH DIVERSE *XYLELLA FASTIDIOSA* ISOLATES

Principal Investigator:
Mark C. Black
Texas AgriLife Exten. Service
Uvalde, TX 78802
m-black@tamu.edu

Cooperators:
Alfred M. Sanchez
Texas AgriLife Exten. Service
Uvalde, TX 78802
amsanchez@tamu.edu

James L. Davis
Texas AgriLife Exten. Service
Uvalde, TX 78802

Elisha D. Diaz
Sul Ross State University
Uvalde, TX 78801

Armando V. Pepi
Southwest Texas Jr. College
Uvalde, TX 78801

Reporting Period: The results reported here are from work conducted April 2007 to October 2008.

ABSTRACT
Ten plant species with potential benefits as groundcovers in and near vineyards at risk for Pierce's disease were grown in containers in greenhouse and screenhouse for mechanical inoculation with *Xylella fastidiosa* isolated from weed, tree, or grape in Texas. Isolates were from *Ambrosia trifida* var. *texana*, *Helianthus annuus, Iva angustifolia*, *Nerium oleander*, *Platanus occidentalis*, and *Vitis vinifera*. No symptoms developed and evaluations were with ELISA. Based on mechanical inoculations, lower risk (susceptible to fewer isolates and no grape isolates, low test mean ELISA OD, low test mean Rx [proportion OD≥0.300]) species were *Coreopsis tinctoria*, *Verbena rigida*, and *Lolium multiflorum*. Higher risk species were *Phlox drummondii*, *Lupinus texensis*, *Medicago polymorpha*, *M. polymorpha*, *Trifolium incarnatum*, *T. repens*, and *Gaillardia pulchella*. Data from plant species interactions with vector species and senescence dates (vs. vector peak populations) under field conditions may alter our interpretation of risk status.

INTRODUCTION
Pierce's disease (PD) management suggestions include vegetation management in and near vineyards (Black et al., 2005, 2008), including competition from plants that are poor hosts of *Xylella fastidiosa* (*Xf*) and not commonly used by insect vectors. Traits of *Xf*-safe plants may include low cost to establish, re-seed or re-grow from roots/crowns, require minimal maintenance once established, senesce without mowing or herbicide, provide temporary standing mulch, minimal competition with grapevines for water and nutrients, fix nitrogen, affect other pests in neutral or beneficial manner, enhance vector biological control as insectary plants, and/or seasonal tourist appeal.

Our long term approach to ranking species for risk as ground cover includes ELISA testing (positive was OD≥ 0.300, reaction [Rx] was proportion positive) of a) environmental samples from the vicinity of PD vineyards, b) mechanically inoculated greenhouse and/or screenhouse container-grown plants (Black et al., 2006), and c) seeded or transplanted small plots near a PD vineyard. This report addresses only mechanical inoculations with selected isolates (Table 11) in the absence of *Xf* vectors.

OBJECTIVES
Mechanically inoculate diverse Texas *Xf* isolates into potential ground cover plants and compare PD risk in and near vineyards.

RESULTS
Candidate species for vineyard and vicinity use represented Polemoniaceae (Table 1), Fabaceae (Tables 2-6), Asteraceae (Tables 7, 8), Verbeneaceae (Table 9) and Poaceae (Table 10). Every potential ground cover species was infected with one or more Texas *Xf* isolates (Tables 1-10). Species were ranked using arbitrary criteria (number of grape isolate treatment means OD≥0.3, test mean OD≥0.7, test mean Rx≥0.6). Based on mechanical inoculations of container-grown plants, lower risk species were *Coreopsis tinctoria*, *Verbena rigida*, and *Lolium multiflorum*. Higher risk species (susceptible to more isolates and grape isolates, high mean OD, high mean Rx) were *Phlox drummondii*, *Lupinus texensis*, *Medicago polymorpha*, *M. polymorpha*, *Trifolium incarnatum*, *T. repens*, and *Gaillardia pulchella*. Data from plant species interactions with vector species and senescence dates vs. vector peak populations under field conditions may alter our interpretation of risk status.

CONCLUSIONS
No species was immune to grape and non-grape *Xf* isolates. With the criterion of mechanical inoculation in the absence of insect vectore, three plant species may pose low PD risk if used in and near vineyards. Seven plant species may pose significant PD risk if planted or allowed to grow in and near vineyards. Data from field plants exposed to *Xf* vectors are needed to confirm risk status.

REFERENCES CITED

Black, M.C., A.M. Sanchez, J.L. Davis, J.S. Kamas, and P.S. Adams. 2006. Greenhouse responses of *Vitis vinifera* 'Chardonnay,' *Ambrosia trifida* var. *texana*, and *Iva annua* with *Xylella fastidiosa* isolates from Texas host plants. Page 202 in: Proc. 2006 Pierce's Dis. Res. Symp., California Dept. Food Agric., Sacramento, CA.

Black, M., A. Sanchez, J. Davis, J. Kamas, S. Ortiz. 2005. Supplemental *Xylella fastidiosa* hosts found near four central Texas vineyards with or without Pierce's disease histories. Phytopathology 95S:10 (Abstr.)

Black, M., A. Sanchez, J. Davis, J. Kamas, and P. Adams. 2008. More Texas *Xylella fastidiosa* isolates colonized *Helianthus annuus* and *Iva annua* than *Ambrosia trifida* var. *texana* and *Vitis vinifera* 'Chardonnay.' Phytopathology 98S:23 (abstr.).

FUNDING AGENCIES

Funding for this project was provided by the USDA Animal and Plant Health Inspection Service.

Table 1. Responses of Drummond phlox (*Phlox drummondii*) to diverse *Xf*. Test A inoculated 17-25Mar08; evaluated 21May08. Test B inoculated 7-22Apr08; evaluated 16Jun08.

Test	Isolate	OD		Rx			OD	Rx
A	GILGRA288 Ha	2.53	a	1.00	a			
	GILGRA286 At	2.04	ab	1.00	a			
	TRAFLA377 Vv	1.58	bc	1.00	a			
	GIL007 Po	1.47	bc	0.75	abc			
	GILBEC625 Vv	1.18	cd	0.83	ab			
	UVA119 Po	0.68	de	0.58	bc			
	MEDPRI025 No	0.53	ef	0.50	c	**Mean**	**1.26**	**0.71**
	SCP Buffer	0.08	f	0.00	d	**C.V., %**	**57**	**48**
B	GILGRA286 At	2.45	a	1.00	a			
	TRAFLA377 Vv	1.32	b	1.00	a			
	GILBEC625 Vv	1.30	b	0.83	ab			
	GILGRA288 Ha	1.04	b	0.71	bc			
	UVA119 Po	0.50	c	0.50	cd			
	GIL007 Po	0.49	c	0.25	de			
	MEDPRI025 No	0.13	cd	0.08	e	**Mean**	**0.90**	**0.54**
	SCP Buffer	-0.01	d	0.00	e	**C.V., %**	**54**	**60**

Table 2. Responses of Texas bluebonnet (*Lupinus texensis*) to diverse *Xf*. Test A inoculated 13Apr07; evaluated 2May07. Test B inoculated 3-6Dec07, 22-25Jan08; evaluated 14Jan-11Mar08, 8Apr08. Test C inoculated 22-25Jan08; evaluated 8Apr08.

Test	Isolate	OD		Rx		Site	OD		Rx	
A	GILGRA286 At	0.37	a	0.53	a	Inoculation	0.38	a	0.50	a
	TRAFLA302 Vv	0.37	a	0.33	ab	Above	0.10	b	-0.03	b
	GILBEC625 Vv	0.27	ab	0.33	ab					
	GILBEC532 Vv	0.18	b	0.19	ab					
	TRAFLA377 Vv	0.16	b	0.08	b	**Mean**	**0.27**		**0.29**	
	SCP Buffer	0.09	b	-0.06	b	**C.V., %**	**52**		**107**	
B	UVA119 Po	1.74	a	0.85	ab					
	GIL007 Po	1.74	a	0.95	a					
	GILGRA286 At	1.19	b	0.70	b					
	GILGRA288 Ha	1.16	b	0.90	a					
	GILBEC625 Vv	1.15	b	0.68	b					
	TRAFLA377 Vv	1.03	b	0.90	a	**Mean**	**1.13**		**0.72**	
	SCP	-0.13	c	0.01	c	**C.V., %**	**40**		**40**	
C	GILGRA286 At	1.99	a	1.56	a	Inoculation	0.89	a	0.79	a
	GILGRA288 Ha	1.67	b	1.51	a	Above	0.77	b	0.70	b
	GIL007 Po	0.67	c	0.49	b					
	UVA119 Po	0.53	c	0.51	b					
	TRAFLA377 Vv	0.45	c	0.51	b					
	GILBEC625 Vv	0.43	d	0.66	b	**Mean**	**0.83**		**0.74**	
	SCP	0.07	e	-0.03	c	**C.V., %**	**32**		**41**	

Table 3. Responses of burr medic (*Medicago polymorpha* 'Armadillo') to diverse *Xf*. Test A inoculated 17-25Mar08; evaluated 23Apr08.

Test	Isolate	OD		Rx			OD	Rx
A	GILGRA288 Ha	1.58	a	1.00	a			
	GIL007 Po	1.36	ab	1.00	a			
	GILGRA286 At	1.30	ab	0.92	ab			
	TRAFLA377 Vv	1.23	ab	1.00	a			
	UVA119 Po	1.18	ab	0.83	ab			
	GILBEC625 Vv	1.02	bc	1.00	a			
	MEDPRI025 No	0.68	c	0.75	b	**Mean**	**1.06**	**0.81**
	SCP Buffer	0.11	d	0.00	c	**C.V., %**	**49**	**29**

Table 4. Responses of small burr medic (*Medicago polymorpha* 'Devine') to diverse *Xf*. Test A inoculated 17-25Mar08; evaluated 28Apr08. Test B inoculated 7-22Apr08; evaluated 28May08.

Test	Isolate	OD		Rx		Site	OD		Rx	
A	UVA119 Po	2.71	a	1.00	a	Inoculation	1.89	a	0.88	a
	GILGRA286 At	2.45	ab	1.00	a	Above	1.72	b	0.77	b
	GIL007 Po	2.34	b	1.00	a					
	GILBEC625 Vv	2.22	bc	1.00	a					
	GILGRA288 Ha	2.17	bc	1.00	a					
	TRAFLA377 Vv	1.94	c	1.00	a					
	MEDPRI025 No	0.51	d	0.58	b	**Mean**	**1.81**		**0.82**	
	SCP Buffer	0.11	e	0.00	c	**C.V., %**	**23**		**22**	
B	GILGRA286 At	3.16	a	1.02	a					
	UVA119 Po	2.92	ab	1.00	a					
	GILGRA288 Ha	2.90	ab	1.02	a					
	GIL007 Po	2.47	ab	1.02	a					
	MEDPRI025 No	1.74	c	1.00	a					
	GILBEC625 Vv	1.50	cd	0.75	b					
	TRAFLA377 Vv	1.10	cd	0.75	b	**Mean**	**1.86**		**0.79**	
	SCP Buffer	0.15	e	0.00	c	**C.V., %**	**34**		**31**	

Table 5. Responses of crimson clover (*Trifolium incarnatum*) to diverse *Xf*. Test A inoculated 7-22Apr08; evaluated 14May08. Test B inoculated 29Apr-5May08; evaluated 3Jun08.

Test	Isolate	OD		Rx			OD	Rx
A	GILGRA286 At	1.37	a	1.00	a			
	GILBEC625 Vv	1.33	a	1.00	a			
	UVA119 Po	1.22	ab	0.83	a			
	GIL007 Po	1.12	ab	0.92	a			
	GILGRA288 Ha	0.97	abc	1.00	a			
	MEDPRI025 No	0.83	bc	0.83	a			
	TRAFLA377 Vv	0.58	cd	0.92	a	**Mean**	**0.96**	**0.83**
	SCP Buffer	0.26	d	0.17	b	**C.V., %**	**56**	**34**
B	GILGRA288 Ha	1.86	a	0.92	ab			
	GILBEC625 Vv	1.77	a	0.92	ab			
	GILGRA286 At	1.76	a	0.75	ab			
	TRAFLA377 Vv	1.65	a	1.00	a			
	MEDPRI025 No	1.53	a	0.83	ab			
	UVA119 Po	1.49	a	0.67	b			
	GIL007 Po	1.47	a	0.75	ab	**Mean**	**1.45**	**0.73**
	SCP Buffer	0.07	b	0.00	c	**C.V., %**	**58**	**46**

Table 6. Responses of white clover (*Trifolium repens* 'Durana') to diverse *Xf*. Test A inoculated 1-8Apr08; evaluated 9Jun08. Test B inoculated 16-23Apr08; evaluated 10Jun08.

Test	Isolate	OD		Rx			OD	Rx
A	TRAFLA377 Vv	1.62	a	1.00	a			
	MEDPRI025 No	1.52	ab	0.83	ab			
	GILGRA286 At	1.16	abc	0.67	b			
	GILBEC625 Vv	1.15	abc	0.83	ab			
	GILGRA288 Ha	1.09	bc	0.83	ab			
	GIL007 Po	1.05	bc	0.83	ab			
	UVA119 Po	0.94	c	0.75	ab	**Mean**	**1.07**	**0.72**
	SCP Buffer	0.04	d	0.00	c	**C.V., %**	**57**	**47**
B	MEDPRI025 No	1.59	a	1.00	a			
	GILGRA286 At	1.19	b	1.00	a			
	GIL007 Po	1.09	b	0.92	a			
	GILBEC625 Vv	0.86	bc	0.75	ab			
	GILGRA288 Ha	0.74	c	0.83	a			
	UVA119 Po	0.67	cd	0.50	b			
	TRAFLA377 Vv	0.37	de	0.50	b	**Mean**	**0.82**	**0.69**
	SCP Buffer	0.03	e	0.00	c	**C.V., %**	**52**	**49**

Table 7. Responses of plains coreopsis (*Coreopsis tinctoria* var. *tinctoria*) to diverse *Xf*. Test A inoculated 7-22Apr08; evaluated 18Jun08. Test B inoculated 29Apr-5May08; evaluated 24Jun08.

Test	Isolate	OD		Rx		Site	OD		Rx
a	GILGRA288 Ha	1.19	a	0.92	a				
	GILGRA286 At	0.96	b	1.00	a				
	GIL007 Po	0.22	c	0.20	b				
	UVA119 Po	0.05	c	0.00	c				
	TRAFLA377 Vv	0.05	c	0.00	c				
	GILBEC625 Vv	0.03	c	0.00	c				
	SCP Buffer	0.03	c	0.00	c	**Mean**	**0.32**		**0.27**
	MEDPRI025 No	0.02	c	0.00	c	**C.V., %**	**78**		**63**
B	GILGRA286 At	1.14	a	0.83	a	Inoculation	0.264	b	0.27
	GILGRA288 Ha	0.80	b	0.83	a	Above	0.418	a	0.31
	UVA119 Po	0.39	c	0.42	b				
	GIL007 Po	0.20	cd	0.17	bc				
	MEDPRI025 No	0.06	d	0.08	c				
	GILBEC625 Vv	0.05	d	0.00	c				
	TRAFLA377 Vv	0.05	d	0.00	c	**Mean**	**0.34**		**0.29**
	SCP Buffer	0.04	d	0.00	c	**C.V., %**	**98**		**109**

Table 8. Responses of Indian blanket (*Gaillardia pulchella* var. *pulchella*) to diverse *Xf*. Test A inoculated 1-8Apr08; evaluated 18Jun08. Test B inoculated 16-23Apr08; evaluated 23Jun08.

Test	Isolate	OD		Rx			OD	Rx
A	GILGRA286 At	2.53	a	1.00	a			
	GIL007 Po	2.42	a	1.00	a			
	UVA119 Po	2.38	a	1.00	a			
	GILGRA288 Ha	2.34	a	1.00	a			
	GILBEC625 Vv	2.29	a	1.00	a			
	TRAFLA377 Vv	1.25	b	0.67	b			
	MEDPRI025 No	0.19	c	0.17	c	**Mean**	**1.68**	**0.73**
	SCP Buffer	0.02	c	0.00	c	**C.V., %**	**23**	**31**
B	GILGRA286 At	2.76	a	1.00	a			
	GILGRA288 Ha	2.74	a	1.00	a			
	GIL007 Po	2.24	ab	1.00	a			
	UVA119 Po	1.91	bc	0.92	ab			
	TRAFLA377 Vv	1.46	c	0.67	b			
	GILBEC625 Vv	1.35	c	0.75	ab			
	MEDPRI025 No	0.26	d	0.33	c	**Mean**	**1.60**	**0.72**
	SCP Buffer	0.08	d	0.08	c	**C.V., %**	**45**	**44**

Table 9. Responses of tuber vervain (*Verbena rigida*) to diverse *Xf*. Test A inoculated 17-25Mar08; evaluated 14Jul08. Test B inoculated 7-22Apr08; evaluated 15Jul08. Test C inoculated 9-17Jun08; evaluated 13oct08.

Test	Isolate	OD		Rx		Site	OD		Rx	
	GILGRA286 At	1.08	a	0.79	a	Inoculation	0.462	a	0.40	ab
	GILGRA288 Ha	0.70	b	0.67	a	Above	0.588	a	0.48	a
	UVA119 Po	0.44	c	0.46	b	Below	0.258	b	0.27	b
	GILBEC625 Vv	0.23	d	0.33	b	Other stem	0.087	c	0.06	c
	TRAFLA377 Vv	0.11	d	0.04	c					
	GIL007 Po	0.11	d	0.08	c					
	SCP Buffer	0.08	d	0.04	c	**Mean**	**0.35**		**0.30**	
	MEDPRI025 No	0.05	d	0.00	c	**C.V., %**	**102**		**108**	
	GILGRA286 At	1.13	a	0.79	a	Inoculation	0.53	a	0.46	a
	GILGRA288 Ha	0.70	b	0.54	b	Above	0.471	ab	0.44	a
	UVA119 Po	0.39	c	0.42	b	Below	0.324	b	0.25	b
	TRAFLA377 Vv	0.16	d	0.21	c	Other stem	0.078	c	0.06	c
	GILBEC625 Vv	0.15	d	0.21	c					
	MEDPRI025 No	0.10	d	0.13	c					
	SCP Buffer	0.09	d	0.08	c	**Mean**	**0.35**		**0.30**	
	GIL007 Po	0.07	d	0.04	c	**C.V., %**	**112**		**119**	
	GILGRA286 At	0.51	a	0.38	ab	Inoculation	0.238	a	0.20	a
	GILGRA281 At	0.47	a	0.50	a	Above	0.23	a	0.20	a
	LLAFAL650 Ha	0.24	b	0.29	b	Below	0.144	ab	0.09	b
	TRAFLA345 Vv	0.11	bc	0.08	c	Other stem	0.107	b	0.07	b
	LLAFAL718 Ig	0.07	c	0.00	c					
	GILBEC530 Vv	0.07	c	0.00	c					
	GILBEC625 Vv	0.07	c	0.04	c					
	TRAFLA344 Vv	0.04	c	0.00	c	**Mean**	**0.18**		**0.14**	
	SCP	0.04	c	0.00	c	**C.V., %**	**145**		**201**	

Table 10. Responses of annual ryegrass (*Lolium multiflorum* 'Jumbo') to diverse *Xf*. Test A inoculated 17-25Mar08; evaluated 5Jun08. Test B inoculated 7-22Apr08; evaluated 5Jun08.

Test	Isolate	OD		Rx			OD	Rx
A	GILGRA288 Ha	1.48	a	1.48	a			
	GILGRA286 At	1.31	a	1.31	a			
	MEDPRI025 No	1.08	ab	1.08	ab			
	GIL007 Po	0.65	bc	0.65	bc			
	TRAFLA377 Vv	0.30	cd	0.30	cd			
	GILBEC625 Vv	0.19	d	0.19	d			
	UVA119 Po	0.16	d	0.16	d	**Mean**	**0.65**	**0.52**
	SCP Buffer	0.01	d	0.01	d	**C.V., %**	**83**	**66**
B	GILGRA286 At	0.67	a	0.50	a			
	GILGRA288 Ha	0.44	ab	0.50	a			
	MEDPRI025 No	0.20	bc	0.17	b			
	TRAFLA377 Vv	0.16	c	0.25	ab			
	GIL007 Po	0.15	c	0.25	ab			
	GILBEC625 Vv	0.14	c	0.17	b			
	UVA119 Po	0.05	c	0.00	b	**Mean**	**0.23**	**0.23**
	SCP Buffer	0.00	c	0.00	b	**C.V., %**	**133**	**170**

Table 11. Host plant origins of *Xf* isolates.

Acronym	Family	Species	Common name
At	Asteraceae	*Ambrosia trifida* var. *texana*	Giant ragweed
Ha	Asteraceae	*Helianthus annuus*	Common sunflower
Ig	Asteraceae	*Iva angustifolia*	Narrowleaf sumpweed
No	Asclepiadaceae	*Nerium oleander*	Oleander
Po	Platanaceae	*Platanus occidentalis*	American sycamore
Vv	Vitaceae	*Vitis vinifera*	European grape