FAUNISTIC ANALYSIS OF SHARPSHOOTERS IN PLUM ORCHARDS OF RIO GRANDE DO SUL STATE, BRAZIL

Principal Investigator:
João R. S. Lopes
ESALQ/Univ. Sao Paulo
Piracicaba, SP 13418-900
Brazil
jlopes@esalq.usp.br

Researchers:
Cristiane Müller
ESALQ/Univ. Sao Paulo
Piracicaba, SP 13418-900
Brazil

Wilson Azevedo Filho
Univ. Caxias do Sul
Caxias do Sul, RS
CEP 95070 Brazil

Marcos Bottom
Embrapa Uva e Vinho
Bento Gonçalves, RS
CEP 95700 Brazil

Reporting Period:

ABSTRACT
Plum leaf scald (PLS) is a severe disease caused by *Xylella fastidiosa (Xf)*, which drastically affects cultivation of plum in Brazil, but little is known about its epidemiology. We carried out faunistic analyses of sharpshooter leafhoppers in two plum orchards of Rio Grande do Sul (RS) State, in order to identify potential vectors in this crop, based on their ecological characteristics. Sharpshooters were sampled fortnightly by yellow sticky cards placed on the plum tree canopy (1.7 m above ground) and just above the ground vegetation (0.5 m), in 10 sampling points per orchard. A total of 23 and 18 species were trapped in orchards located in the municipalities of Farroupilha and Bento Gonçalves, respectively, in 50 sampling dates from Sept/2006 to Sept/2008. Seven sharpshooters were classified as predominant (dominant, very abundant, very frequent and constant) in the plum orchards: *Bucephalogonia xanthophis* (Berg), *Dilobopterus dispar* (Germar), *Erythrogonia dorsalis* (Signoret), *Macugonalia cavifrons* (Stal), *Molomea lineiceps* Young, *Sibovia sagata* (Signoret) and *Spinagonalia rubrovittata* Cavichioli. Among them, *D. dispar, M. cavifrons* and *M. lineiceps* are likely associated with disease spread because of their activity on the plum canopy. Considering the diversity of sharpshooter species in plum orchards, additional data on spatial patterns of disease, alternative hosts of *Xf*, vector infectivity and transmission efficiency are needed to determine key vectors for PLS spread.

INTRODUCTION
A major factor limiting cultivation of plum in Brazil is the widespread occurrence of Plum leaf scald (PLS), a bacterial disease caused by *Xylella fastidiosa* (*Xf*) (Raju et al. 1982). First detected in plum in Pelotas, Rio Grande do Sul (French & Kitajima, 1978), PLS is now endemic in most plum production areas not only in RS, but also in the states of Santa Catarina, Paraná, São Paulo and Minas Geraes (Ducroquet et al. 2001). This disease is thought to be the main reason for the decline in cultivated areas of plum since the 1970's (Leite et al., 1997; Hickel et al., 2001). *Xf* can be transmitted by several species of leafhoppers in the subfamily Cicadellinae (Hemiptera: Cicadellidae), commonly known as sharpshooters, and by a few spittlebugs (Redak et al. 2004). Despite the importance of PLS in Brazil, sharpshooters involved in the spread of this disease have not been identified. The only vector survey in this crop was done with sweep nets and Moericke yellow water-pan traps in orchards of a single locality in the State of Santa Catarina, Brazil, indicating the presence of five sharpshooter and two spittlebug species (Hickel et al. 2001). However, little information on activity and abundance of these potential vectors in plum orchards is available. Because there is virtually no specificity for transmission of *Xf* within Cicadellinae (Almeida et al. 2005), any sharpshooter species that visit host plants of this bacterium is a potential vector. Indeed, three sharpshooter species found by Hickel et al. (2001) in plum orchards [*Bucephalogonia xanthophis* (Berger), *Ferrariana trivittata* (Signoret) and *Plesiommata corniculata* Young] have been reported as vectors of *Xf* in citrus (Redak et al. 2004). In order to identify potential vectors of *Xf* in plum, we carried out a faunistic analysis of Cicadellinae species in two orchards of the 'Serra Gaúcha', a major production region in State of Rio Grande do Sul, Brazil.

OBJECTIVES
1. Determine the composition of sharpshooter (Cicadellinae) species in plum orchards of Rio Grande do Sul, Brazil.
2. Identify predominant species based on faunistic indices.
3. Determine potential vectors of *Xf* based on prevalence in the orchards and activity on the plum canopy.

RESULTS
We sampled sharpshooters in two plum orchards located in the municipalities of Farroupilha and Bento Gonçalves, State of Rio Grande do Sul, from September 2006 to September 2008. In Farroupilha, the survey was carried out in 1-half orchard of European plum (*Prunus domestica* L.) cv. Italianinha, located in a hilly area surrounded by woody vegetation (29° 08' 47''S, 51° 23' 21'' W). The orchard was five years old when the survey started, and >20% trees showed PLS symptoms. In Bento Gonçalves, the experimental area (1 half) was a four-year old orchard of *P. domestica* cv. Italianinha and Rubimel, located in the District of Pinto Bandeira (29° 07' 43'' S, 51° 26' 58'' W). The orchard was neighbored by a road in one edge and by peach orchards in the other edges, and showed 10% trees with PLS symptoms. The ground vegetation of these two orchards was comprised mainly by grasses [*Digitaria sanguinalis* (L.) Scop., *Paspalum conjugatum* P.J. Bergius and *Brachiaria plantaginea* (Link) Hitchc.] and herbs of the Polygonaceae (*Rumex obtusifolius* L.), Asteraceae (*Bidens pilosa* L., *Galinsoga parviflora* H. St. John & D. White), Fabaceae (*Trifolum repens* L.) families. Sharpshooters were sampled by rectangular (8.5 x 11.5 cm) yellow sticky cards (Biocontrole®, Sao Paulo, SP, Brazil). Two cards were installed per sampling point in 10

points that were spaced 35 m apart, in two lines. In each point, one card was attached to a wood stick at a height of 0.5 m above soil, and the other was fixed on the north face of the plum canopy, at a height of 1.7 m. We exchanged the yellow sticky cards every 15 days and the trapping data of all sharpshooter species were submitted to a faunistic analysis. Prevalent species were determined based on higher constancy, frequency, abundance and dominance índices (Silveira Neto et al., 1995). We also calculated indices of diversity of Shannon-Weaner (H'), equitability (E) and similarity of sharpshooter species for the two experimental orchards.

In Bento Gonçalves, a total of 214 individuals of 18 species of sharpshooter leafhoppers were trapped by yellow sticky traps in 50 sampling dates. Based on the faunistic analysis, eight species were dominant and four of them, *B. xanthophis*, *Erythrogonia dorsalis* (Signoret)*, Macugonalia cavifrons* (Stal) and *Molomea lineiceps* Young were classified as predominant because they were also very abundant, very frequent and constant (**Table 1**). In Farroupilha, 899 specimens of 23 species were captured in the 50 sampling dates. Five out of 13 dominant species in this locality were considered predominant, *Dilobopterus dispar* (Germar), *E. dorsalis*,, *M. cavifrons*, *Sibovia sagata* (Signoret) and *Spinagonalia rubrovittata* Cavichioli (**Table 2**).

The diversity index (H') was significantly higher in the plum orchard of Farroupilha (2.26) compared with Bento Gonçalves (2.18) ($P<0.05$), showing that the two areas were distinct regarding the composition of sharpshooter species, with higher diversity in the former one. Species richness was also higher in Farroupilha, but there was no difference in the equitability index between the two locations, indicating uniformity in abundance of sharpshooter species in the two communities. The higher diversity of species in the plum orchard of Farroupilha may be explained by the presence of adjacent woody vegetation with a variety of native trees, which might serve as natural hosts for a larger number of sharpshooter species, as well as a refugium when the orchard does not offer adequate conditions for feeding or reproduction of these insects.

Concerning the sharpshooter activity on the plum canopy, measured by trap catches at 1.7 m above ground, we noticed that most species from tribe Proconiini were captured mainly on the tree canopy, in both areas (**Tables 1 and 2**). Conversely, Cicadellini species (including the very abundant *E. dorsalis*) were usually trapped in much larger numbers at 0.5 m, which suggests a greater activity of these species on the ground vegetation (herbaceous plants); an exception was *D. dispar*, captured mostly (89%) on the tree canopy. Among the predominant species, *D. dispar, M. cavifrons* and *M. lineiceps* were the most trapped on the plum canopy. Other less abundant dominant species, e.g. *B. xanthophis*, *Oncometopia facialis* (Signoret), *O. fusca* Melichar and *Pawiloma victima* (Germar), were also trapped in significant numbers on the tree canopy. Considering that the probability of *Xf* transmission is enhanced by vector abundance, natural infectivity and preference for the host plant (Purcell 1981), these sharpshooters trapped more frequently on the plum canopy are more likely to play an important role in PLS epidemiology. Two of them, *B. xanthophis*, *O. facialis*, are considered key vectors of *Xf* in citrus orchards, for similar reasons (Lopes, 1999; Almeida et al. 2005). It should be noted, however, that abundant sharpshooter in the ground vegetation of plum orchards, such as *E. dorsalis*, *S. sagata* and *S. rubrovittata* (**Table 2**), may also be important for disease spread if the pathogen colonizes herbaceous weedy hosts. Information on spatial patterns of PLS, possible alternative hosts of the pathogen in plum orchards, as well as on sharpshooters associated with those hosts, will be critical to determine key vectors for PLS epidemiology. Because most sharpshooters tested for transmission of *Xf* to other host plants have been confirmed as vectors (Redak et al. 2004), we expect that sharpshooters considered here as potential vectors will be shown to transmit the causal agent of PLS if tested in future studies.

CONCLUSIONS

Plum orchards in Rio Grande do Sul, Brazil show a high diversity of sharpshooter species that may serve as vectors of *Xf*, particularly in areas surrounded by native woody vegetation. The faunistic analyses classified five sharpshooter species as predominant in the plum orchards: *B. xanthophis*, *D. dispar*, *E. dorsalis, M. cavifrons*, *M. lineiceps, S. sagata* and *S. rubrovittata* (**Tables 1 and 2**). Among them, *D. dispar, M. cavifrons* and *M. lineiceps* are likely associated with spread of PLS because of their higher activity on the plum canopy.

REFERENCES CITED

Almeida RPP, Blua MJ, Lopes, JRS, Purcell AH. 2005. An. Entomol. Soc. Am. 98: 775-786.
Ducroquet JPHJ, Andrade ER, Hickel ER. 2001. Florianópolis: Epagri, 55p. (Epagri Boletim Técnico, 118).
French, WJ, Kitajima EW. 1978. Plant Disease Report, 62, 12: 1035-1038.
Hickel ER, Ducroquet JPHJ, Leite Júnior RP, Leite RMVBC. 2001. Neotrop. Entomol., 30,.4:725-729.
Leite RMVBC, Leite Júnior RP, Ceresini PC. 1997. Fitopatol. Bras., 22: 54-57.
Lopes JRS. 1999. Laranja, Cordeirópolis, SP, 20: 329-344.
Purcell AH. 1981. Phytopathology, 71:429-435.
Redak RA, Purcell AH, Lopes JRS, Blua MJ, Mizell RF, Andersen PC. 2004. Annu. Rev. Entomol., 49: 243-270.
Raju BC, Wells JM, Nyland G, Brlansky RH, Lowe SK. 1982. Phytopathology: 72:1460-1466.
Silveira Neto S, Monteiro RC, Zucchi RA, Moraes RCB. 1995. Scientia Agrícola, 52:1:9-15.

FUNDING AGENCIES
Funding for this project was provided by Conselho Nacional Desenvolv. Cientif. e Tecnol. (CNPq) (485868/2007-5).
C. Muller received a scholarship from Fundação de Apoio à Pesquisa do Estado de S. Paulo (FAPESP) (06/60024-7).

Table 1. Total number of individuals and faunistic indices of leafhopper species of the subfamily Cicadellinae trapped by yellow sticky traps in a plum orchard of Bento Gonçalves, Rio Grande do Sul, Brazil, from September/2006 to September/2008.

Leafhopper species	Total [1]	Faunistic indices				Capture (%) per trap height	
		D [2]	A [3]	F [4]	C [5]	0,5 m	1,7m
Tribe Cicadellini							
Bucephalogonia xanthophis (Berg, 1879)*	34	D	va	VF	W	100	-
Caragonalia sp.	1	ND	r	LF	Z	-	100
Diedrocephala variegata (Fabricius, 1775)	2	ND	d	LF	Z	50	50
Dilobopterus dispar (Germar, 1821)	2	ND	d	LF	Z	88	12
Erythrogonia dorsalis (Signoret, 1853)*	30	D	va	VF	W	97	3
Macugonalia cavifrons (Stal, 1862) *	30	D	va	VF	W	73	27
Macugonalia geografica	1	ND	r	LF	Z	100	1
Macugonalia leucomelas (Walker, 1851)	2	ND	d	LF	Z	50	50
Morfo 5	1	ND	r	LF	Z	-	100
Pawiloma victima (Germar, 1821)	9	D	c	F	Y	50	50
Sibovia sagata (Signoret, 1854)	5	ND	c	F	Y	100	-
Spinagonalia rubrovittata Cavichioli 2008	11	D	c	F	W	90	10
Tribe Proconiini							
Molomea consolida Schoder, 1959	2	ND	d	LF	Z	50	50
Molomea lineiceps Young, 1968*	60	D	va	VF	W	15	85
Molomea personata (Signoret, 1854)	1	ND	r	LF	Z	-	100
Oncometopia facialis (Signoret,1854)	8	D	c	F	Y	25	75
Oncometopia fusca Melichar, 1925	14	D	c	F	W	52	48
Homalodisca ignorata Melichar, 1924	1	ND	r	LF	Z	-	100

[1] Total number of individuals of each species captured in all traps and sampling dates
[2] Dominance - D: dominant; ND: non-dominant
[3] Abundance – va: very abundant; c: common; d: dispersive; r: rare
[4] Frequency – VF: very frequent; F: frequent; LF: little frequent
[5] Constancy – W: constant; Y: accessory; Z: accidental
* predominant species

Table 2. Total number of individuals and faunistic indices of leafhopper species of the subfamily Cicadellinae trapped by yellow sticky traps in a plum orchard of Farroupilha, Rio Grande do Sul, Brazil, from September/2006 to September/2008.

Leafhopper species	Total [1]	Faunistic indices				Capture (%) per trap height	
		D [2]	A [3]	F [4]	C [5]	0,5 m	1,7m
Tribe Cicadellini							
Bucephalogonia xanthophis (Berg, 1879)	37	D	c	F	W	64	36
Caragonalia sp	1	ND	r	LF	Z	-	100
Diedrocephala variegata (Fabricius, 1775)	11	D	d	LF	Y	90	10
Dilobopterus dispar (Germar, 1821) *	185	D	va	VF	W	11	89
Erythrogonia dorsalis (Signoret, 1853)*	114	D	va	VF	W	95	5
Hortensia similis (Walker, 1951)	1	ND	r	LF	Z	100	-
Macugonalia sp.	9	D	d	LF	Y	100	-
Macugonalia cavifrons (Stal, 1862) *	215	D	va	VF	W	60	40
Morfo 5	5	ND	r	LF	Z	60	40
Morfo 2	4	ND	r	LF	Z	100	-
Morfo 9	1	ND	r	LF	Z	100	-
Morfo 8	2	ND	r	LF	Z	100	-
Pawiloma victima (Germar, 1821)	11	D	d	LF	Y	72	28
Fonsecaiulus sp.	18	D	c	F	Y	72	28
Sonesimia sp.	1	ND	r	LF	Z	-	100
Sibovia sagata (Signoret, 1854) *	74	D	va	VF	W	84	16
Spinagonalia rubrovittata Cavichioli 2008*	77	D	va	VF	W	88	12
Tribe Proconiini							
Aulacizes quadripunctata (Germar, 1821)	1	ND	r	LF	Z	-	100
Molomea consolida Schoder, 1959	3	ND	r	LF	Z	67	33
Molomea lineiceps Young, 1968	32	D	c	F	Y	3	97
Oncometopia facialis (Signoret,1854)	61	D	c	F	Y	19	81
Oncometopia fusca Melichar, 1925	26	D	c	F	W	27	73
Tapajosa rubromarginata (Signoret, 1855)	1	ND	r	LF	Z	-	100

[1] Total number of individuals of each species captured in all traps and sampling dates
[2] Dominance - D: dominant; ND: non-dominant
[3] Abundance – va: very abundant; c: common; d: dispersive; r: rare
[4] Frequency – VF: very frequent; F: frequent; LF: little frequent
[5] Constancy – W: constant; Y: accessory; Z: accidental
* predominant species