PENTATOMIDS ASSOCIATED WITH BLACKBERRY

Pentatomídeos associados à amoreira-preta

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ABSTRACT

Information concerning the presence of stink bugs in blackberry (*Rubus* spp.) in Brazil is sparse. This study aimed to identify the stink bug species associated with blackberry, to establish the daily dynamics and evaluate the fruits damage. The experiment was conducted in Santa Maria, Rio Grande do Sul State, Brazil, in blackberry orchard. Presence and evaluations of stink bugs were done weekly through visual and sweeping samplings at different day times. Five species of pentatomids were identified: *Piezodorus guildinii*, *Nezara viridula*, *Euschistus heros*, *Dichelops furcatus* and *Edessa meditabunda*. The bugs attack the drupelets producing a dark brown spot and wrinkled berries.

Index terms: *Dichelops furcatus*, *Euschistus heros*, *Edessa meditabunda*, *Nezara viridula*, *Piezodorus guildinii.*

RESUMO

São escassas as informações referentes à presença de pentatomídeos na amoreira-preta no Brasil (*Rubus* spp.). Este trabalho teve por objetivos de identificar as espécies de pentatomídeos associadas à amoreira-preta, realizar a análise faunística e determinar seus danos em frutos. O experimento foi conduzido em Santa Maria, Rio Grande do Sul, Brasil, em pomar de amoreira-preta. Semanalmente, foram realizadas avaliações visuais sobre amoras e amostragens por batimento para identificação dos pentatomídeos associados e caracterização de danos, realizadas em diferentes horários do dia. Foram determinadas cinco espécies de pentatomídeos associadas amoreira-preta: *Piezodorus guildinii*, *Nezara viridula*, *Euschistus heros*, *Dichelops furcatus* e *Edessa meditabunda*. Esses percevejos atacam as mini-drupas deixando-as com aspecto marrom escuro e enrugado.

Termos para indexação: *Dichelops furcatus*, *Euschistus heros*, *Edessa meditabunda, Nezara viridula*, *Piezodorus guildinii.*

INTRODUCTION

The blackberry, *Rubus* spp. (Rosaceae), area has shown substantial increase in Rio Grande do Sul (RS) State, Brazil. This crop is an alternative to small scale growers, due to the low cost production (Antunes; Rasseira, 2004).

Stink bugs are common in annual crops, mainly corn, soybeans and rice. In absence of these crops stink bugs move to other crops to feed. Blackberry orchards are usually located close to annual crops, and they are appropriated host for stink bugs. No insect has been reported on blackberries in Brazil (Antunes; Rasseira, 2004, Pagot et al., 2007). In the United States, eight species of stink bugs have been reported associated with blackberry, including *Nezara viridula* (L.) and *Euschistus* spp. (Brennan et al., 2013).

Analysis of the faunal composition and insect activity are fundamental to the establishment of management strategies (Uramoto; Walter; Zucch, 2005). So, this study aimed to identify the stink bugs species associated with blackberries, establish the daily dynamics and determine fruit damage.

MATERIAL AND METHODS

The work was conducted in an experimental ten year old blackberry orchard, cv Guarani, during November and December 2011, at Santa Maria, Rio Grande do Sul, Brazil (Lat. -29.650313º and e Long. -54.07167º). The climate matches to Cfa according with köppen classification (Heldwein; Buriol; Streck; 2009). Samplings were performed throughout five weeks during fruit development in a delimited area of 1 x 60 m (60 m^2). The data was collected at 8h, 10h, 14h, 16h and 18h.

Samplings were done by using a metal beat tray with area of 0.6 m^2 placed under the plant canopy. Ten beat samplings were done, five on each side of the canopy (East – E and Western – W), one for each plant.

The plants were beaten upon the tray and the insects preserved in Alcohol. At the same time a visual plant survey was done to detect bugs and quantify damages.

The data was analyzed as a factorial 2x5 with split plot in time (Factor A = both sides of the canopy in the main plot and Factor D = five different evaluation times in the subplot on time), in randomized block design with five replications considering the different day samplings as blocks. Data was tested for normality of errors by the Anderson Darling Test. When necessary data was transformed to $(x+0.5)^{1/2}$ before performing Analysis of Variance and Regression Analysis.

Proportional comparisons between different stink bug populations were performed by using the frequency

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of individuals of each species ($p_i = N_i / N$), where n_i is the number of individuals of the species and N ~~is~~ the total number of individuals in ~~of~~ the sample. Estimations were assessed by the R software (R Development Core Team, 2012).

The faunal analysis allows characterizing the community structure and was based on the Shannon Diversity Index (*H'*), Pielou Equitability Index (*J'*), Simpson Index (I_s), Simpson Diversity Index (D_s), Simpson Equitability Index (*ED*) and the Constancy (*C*) (Uramoto; Walter; Zucch 2005; Zar, 2010). The *H'* index measures the degree of uncertainty in predicting which species belong to a randomly chosen individual and lower index value, lower degree of uncertainty, lower sample diversity. The *J'* and *ED* index refers to the individual's distribution pattern of species. The D_s index reflects the probability that two randomly selected individuals in the community belong to the same species. The *C* refers percent of samples in a given species was present.

The index average was analyzed by factorial 2x5 with split plot in time (Factor A = both sides of the canopy in the main plot and Factor D = five different evaluation times in the subplot on time), in randomized block design with five replications considering the different day samplings as blocks. Data was tested for normality of errors by the Anderson Darling Test. When necessary data was transformed to $(x+0.5)^{1/2}$ before performing Analysis of Variance and Regression Analysis.

RESULTS AND DISCUSSION

Five species of stink bugs (Hemiptera: Pentatomidae) were identified associated with *Rubus* spp.: *Piezodorus guildinii* (Westwod), *Euschistus heros* (F.), *Dichelops furcatus* (F.), *Edessa meditabunda* (F.) and *Nezara viridula* (L.). The first four species are new records for blackberries in the world (Panizzi, 1997; Bunde et al., 2010; Brennan et al., 2013). Plants at pod formation stage, unripe and ripe fruits are more attractive to stink bugs than posterior stages (Bundy; McPherson, 2000). Brennan et al. (2013) reported that increasing stink bugs population in blackberry is associated with the increased number of mature fruits.

Beat sampling showed a low presence of *E. meditabunda* (six individuals) and it was not included in the statistical analysis. *D. furcatus* showed a higher frequency, differing from the other species, exceeding two individuals per day. Populations of *N. viridula* and *E. heros* not differ statistically. *P. guildinii* was less frequent differing from the other species (Table 1). Only adults were found during the survey.

Visual evaluations showed *P. guildinii* with the highest frequency, differing from the other species (Table 1). *N. viridula, D. furcatus* and *E. heros* were less frequent. All four species were always found in samplings (constancy) (Table 1). The exposure and strong association between *P. guildinii* with fruits can account for the differences between beat and visual samplings

The analysis of variance of beating sampling for all four species showed only a significant effect of time factor: However, for the species *P. guildinii* and *N. viridula* was significant interaction between both factors. The best fitting model was the quadratic regression. In all species, the sampled population decreased from 8h until 12h (Figure 1) and increased from 14h. The presence of the insects was highest at 8h and 18h. It has already been reported that adult females of *N. viridula* mainly feed during the night (Shearer; Jones, 1996). Between 10h and 14h the insects probably move to other plant sectors, being difficult to reach throughout the sampling method.

The plant sides did not affect the sample population for the species *E. heros* and *D. furcatus*, however, for the stink bugs species *P. guildinii* e *N. viridula* the canopy influenced the sampling population, having a similar behavior for this stink bugs species as shown in figure 1.

The analysis of variance for the visual assessments showed a significant effect of time factor and not significant for the plant side. The best model fits with the quadratic regression (Figure 2). Observations of insect presence showed less insects during warmer hours (12h) increasing in more cooler hours (Figure 2). A similar trend was found by Shearer and Jones (1996) with adult females of *N. viridula*.

Four stink bug species associated with blackberry, *P. guildinii* (Figure 3), *D. furcatus* (Figure 4), *E. heros* (Figure 5) and *N. viridula*, caused wrinkled drupelet appearance and presence of a dark brown spot.

Differences in diversity index, equitability and dominance were found only between sampling. The best adjustment corresponded to the quadratic regression model (Figure 6). The diversity and equitability decreased from the 8h the 14h and increased from the 14h the 18h (Figure 6). High values of diversity indices indicate larger degree of uncertainty in predicting which species belong to a randomly chosen individual, since high values of equitability give the notion of a uniform distribution of individuals by species exist (Zar, 2010). The values of highest diversity also indicated greater uniformity, ie, constant values of the samples stink bugs (Figure 6).

Table 1 – Number of individuals of the species i (n_i), total number of individuals (N), observed frequency (pi) and constancy of stink stink bugs obtained from beat samples and visual evaluations in *Rubus* spp. Santa Maria, Rio Grande do Sul, Brazil, 2011.

Species (i)	*ni*	*pi*	Significance			Constancy [1]
			N. viridula	*E. heros*	*D. furcatus*	
---------------------------------Beat sampling---------------------------------						
Piezodorus guildinii	317	18.6	*	*	*	75.23 (c)
Nezara viridula	383	22.4		ns	*	59.02 (c)
Euschistus heros	379	22.2			*	78.42 (c)
Dichelops furcatus	629	36.8				95.23 (c)
N	1708	100				
---------------------------------Visual sampling-------------------------------						
Piezodorus guildinii	273	43.6	*	*	*	
Nezara viridula	69	11.0		*	*	
Euschistus heros	180	28.8			*	
Dichelops furcatus	104	16.6				
N	626	100				

*Significant at 5% probability of error for two proportions comparison test; ns: not significant. [1]C>50% = constant (c), 25≤C≥50% = accessory (a), C<25% = accidental (ac) (Uramoto; Walter; Zucch 2005).

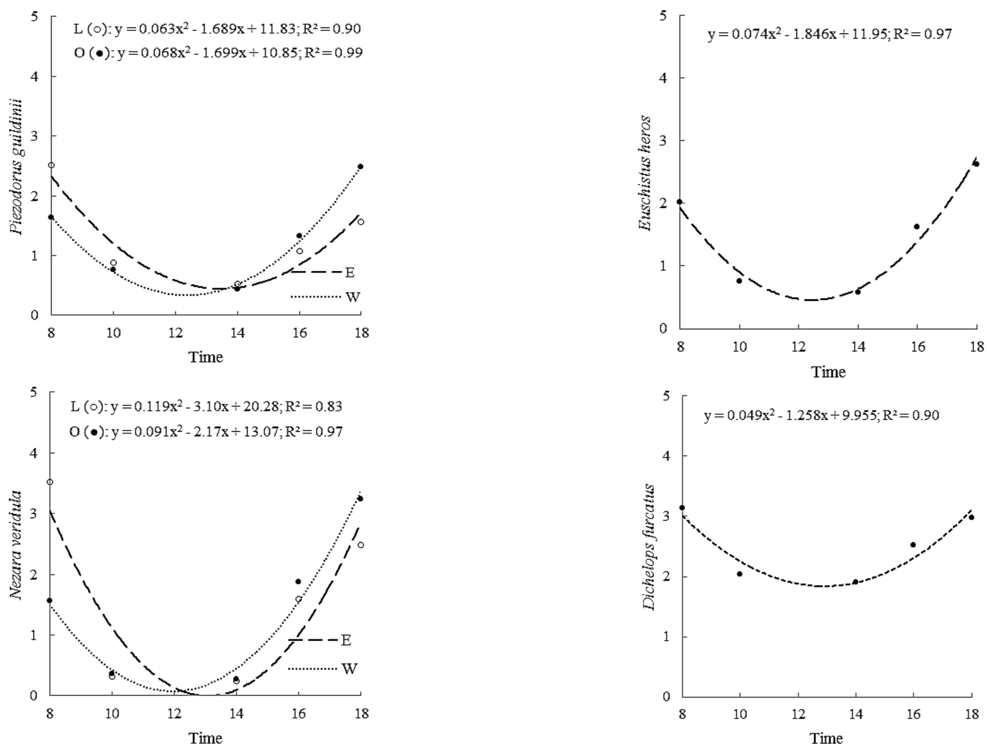

Figure 1 – Average number of *Piezodorus guildinii*, *Euschistus heros*, *Nezara viridula* and *Dichelops furcatus* in function of sampling time in two side East (E) and West (W) in relation the canopy of *Rubus* spp. Santa Maria, Rio Grande do Sul, Brazil, 2011. Graphics showing one line represent similar numbers for sampling positions.

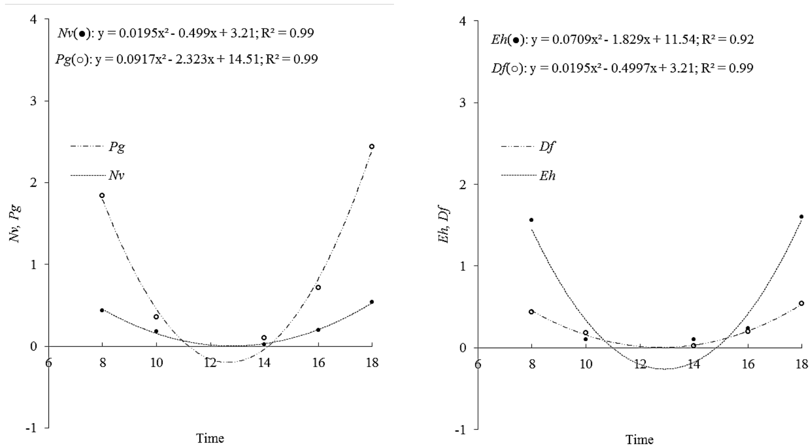

Figure 2 – Average number of stink bugs at different observation times in fruits of *Rubus* spp. Santa Maria, Rio Grande do Sul, Brazil, 2011. *Piezodorus guildinii* (*Pg*), *Nezara viridula* (*Nv*), *Euschistus heros* (*Eh*), *Dichelops furcatus* (*Df*).

Figure 3 – Adults of *Piezodorus guildinii* on blackberries fruits. Santa Maria, Rio Grande do Sul, Brazil, 2011. Red circle shows a stink bug feeding damage.

Figure 4 – Adult of *Dichelops furcatus* on blackberry fruit. Santa Maria, Rio Grande do Sul, Brazil, 2011. Red circle shows a stink bug feeding damage.

Figure 5 – Adult of *Euschistus heros* on blackberry fruit. Santa Maria, Rio Grande do Sul, Brazil, 2011. Red circle shows a stink bug feeding damage.

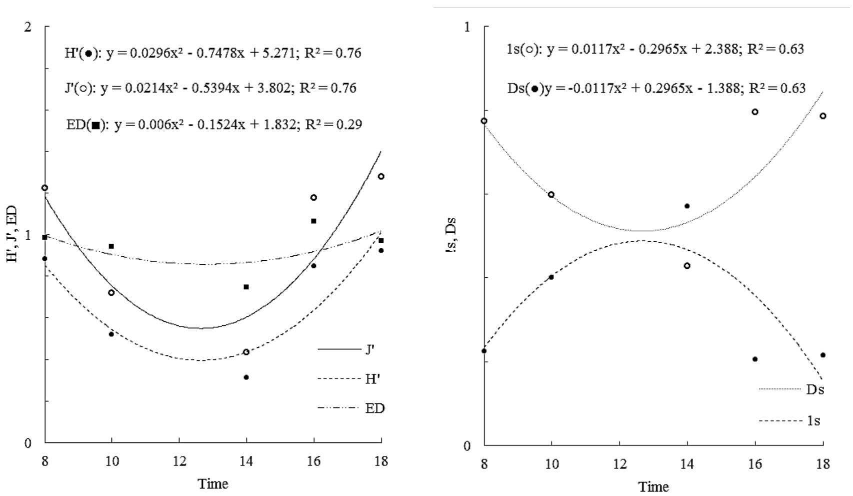

Figure 6 – Shannon Diversity Index (*H'*), Pielou Equitability Index (*J'*), Simpson Equitability Index (*ED*), Simpson Index (1_s) and the Simpson Diversity (D_s) obtained from stink bug samplings at different times on *Rubus* spp. ~~in~~ Santa Maria, Rio Grande do Sul, Brazil, 2011.

CONCLUSIONS

Five species of blackberry pentatomids were determined associated with blackberries: *Piezodorus guildinii*, *Nezara viridula*, *Euschistus heros*, *Dichelops furcatus* and *Edessa meditabunda*. These bugs feed on the drupelets producing a dark brown spot and wrinkled fruits.

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