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Note

Drosophila suzukii **(Matsumura) (Diptera: Drosophilidae) in Peaches: is it a problem?**

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ABSTRACT: Healthy peach fruit is not considered a preferred host for *Drosophila suzukii* (Matsumura); however, it becomes a more preferable host when damaged. Thus, damaged peach fruit is of importance not only in terms of economic losses, but also because it serves as a reservoir for this fly species. This work aimed to evaluate the suitability of peaches mechanically damaged or harboring the brown rot disease as hosts for *D. suzukii* compared to hosts for which they have a low (undamaged peach) and high (undamaged strawberry) preference. Damaged peaches were as susceptible as undamaged strawberries. Fungus infection alone did not increase the susceptibility of peaches compared to undamaged peaches. This information should be considered when an Integrated Pest Management program is defined in a scenario of different species of fruit production.
Keywords: *Prunus*, spotted wing drosophila, damage interactions, brown rot disease

Introduction

Drosophila suzukii (Matsumura) (Diptera: Drosophilidae) is a known pest of small berries such as blackberry, blueberry, raspberry, cherries and strawberries (Bellamy et al., 2013). In Brazil, since its first occurrence in 2013, *D. suzukii* has been causing damage in different crops (Santos, 2014). *D. suzukii* is a highly polyphagous species (Dreves et al., 2009) and can infest, in addition to the small berries, a wide range of hosts including some globally important fruits like grapes and peaches (Bellamy et al., 2013; Cini et al., 2012). In choice experiments, healthy, undamaged packed peaches are not considered a preferred host (Bellamy et al., 2013), suggesting that this pest might not present a problem for the peach production system in the absence of previous damage to fruit in the field. However, it is important to consider broader conditions in the field and fruit integrity, which may alter the interaction with this pest. Damaged peaches might serve as an important reservoir for this species, increasing the pest population in the field and keeping it during the gaps in the production of other more-preferred hosts.

Development of Integrated Pest Management (IPM) practices for *D. suzukii* in southern Brazil is of increasing importance, given the spatial distribution, variability, small acreage and proximity of various cultivated hosts, such as fields of small berries, and other less preferred host, such as peach orchards. For example, natural field infestation of *D. suzukii* in grapes is low when there are only undamaged, healthy grapes; however, field infestation increases when the grapes have natural mechanical damage or diseases (Ioriatti et al., 2015). Peaches also incur fruit damage, from various agents including arthropod pests such as fruit flies or Nitidulidae beetles, fungi such as *Monilinia fructicola* Honey, causing the brown rot disease (the most important in Brazil (Lichtemberg et al., 2016)), birds, or weather events such as hail. Here, we evaluated the interaction between *D. suzukii* infestation and different types of field damages to peaches.

Materials and Methods

Mature 'Marfim' and 'Jubileu' peaches were harvested in a field in Pelotas, Rio Grande do Sul state, Brazil (31°46'19" S, 52°20'24" W, 58 m). The peaches of both cultivars were under different health conditions (treatments): i - undamaged (UND) fruit, non-infested, and accepted by the market; ii - fruit with visible mechanical damage (MD) caused by insects or birds; and iii - fruit with up to 50 % of the surface showing the brown rot disease (BR) (see Batra (1991) for symptoms descriptions). In the laboratory, 50 fruit under each condition from each cultivar were individually placed in cages made from 50 mL plastic cups flipped upside down on acrylic plates (10 × 10 cm), with a vented opening sealed with fine mesh at the top. Inside the cages, the fruit were each infested with four, 4-5 day old *D. suzukii* females. During this period, the insects were deprived of other food sources, but they continued to receive water via hydrophilic cotton. After 24 h, each fruit was removed, the eggs of *D. suzukii* were counted under a stereomicroscope (40x) and placed inside a 500 mL plastic cup with a vermiculite layer at the base. The cups were closed at the top with a fine mesh until the flies emerged. Ripe 'Albion' strawberries (ST) were used as a positive (*D. suzukii*-susceptible) control. Additionally, to assess potential field infestations, all arthropod emergences were recorded for 35 d after fruit harvest.

The experimental design was completely randomized, with three treatments plus a positive control for each cultivar. The resulting data had a Poisson distribution, and were analyzed by generalized linear models (GLM) using the log linking function. The means were compared by the Tukey test ($p \leq 0.0001$, PROC GLM) using SAS (Statistical Analysis System, version 9.3).

Results and Discussion

Drosophila suzukii emergence was not observed in field-collected peach fruit after 10 d housing the fruit post-collection in the laboratory, indicating no *D. suzukii* infestation occurred naturally in the field. Other insects did emerge from fruit in the MD and BR treatments, mainly *Zaprionus indianus* Gupta (Diptera: Drosophilidae) and other unidentified drosophilid species, which were considered natural field infestations (Table 1).

For both cultivars, the UND fruit had only a few eggs laid per female per fruit (Figure 1); however, these eggs were all oviposited on the fruit surface, at the peduncle insertion region, highlighting the inability of *D. suzukii* females to penetrate a healthy peach epidermis to lay eggs. In the 'Jubileu' UND fruit, however, *D. suzukii* emergence was observed (three flies in total; Figure 2). During oviposition in the UND fruit, some eggs hatched and the larvae were trying to penetrate the fruit epidermis, which could explain this result. The humidity at the peduncle insertion region is probably higher, which may prevent the egg from desiccating before it hatches, allowing sporadic infestations in undamaged fruit, if the larvae managed to penetrate the fruit epidermis after the egg hatched.

By contrast, when the fruit of either cultivar had mechanical damage (MD) and especially when the damage was recent and still moist, the infestation occurred at a higher frequency ($F_{3, 156}$ = 25.68, p < 0.0001 for 'Marfim' and $F_{3, 145}$ = 52.9, p < 0.0001 for 'Jubileu'; Figure 1). In 'Marfim' BR peaches, the fungus infection always occurred together with the presence of mechanical damages. BR peaches were infested by the flies as much as MD or ST fruits were ($F_{3, 156}$ = 25.68, p < 0.0001) (Figure 1). However, 'Jubileu' BR fruits did not have mechanical damages for most of the replicates tested. In this last case, oviposition by *D. suzukii* was not observed (Figure 1). These results suggest that mechanical damage is almost essential for a successful *D. suzukii* infestation of peaches. Furthermore, *M. fructicola* may not always increase the susceptibility of peaches to *D. suzukii*, depending on the co-occurrence of mechanical injuries. Susceptibility to *D. suzukii* may also dependent on the peach cultivar. Walsh et al. (2011) recorded *D. suzukii* in Asia infesting wild *Prunus* species, suggesting that some commercially available cultivars may present some degree of susceptibility to this pest.

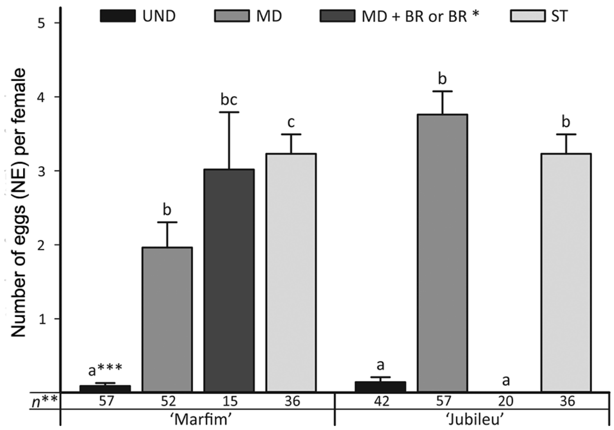

Figure 1 – Number of eggs per female (mean ± SEM) of *Drosophila suzukii* in peaches with different types of field damages: UND = undamaged; MD = mechanical damage; BR = brown rot disease; ST = strawberry (positive susceptible control). *'Marfim': MD + BR and 'Jubileu': only BR; **Number of replicates; ***Columns followed by the same letter within each cultivar do not differ by the Tukey test at 1 % probability level.

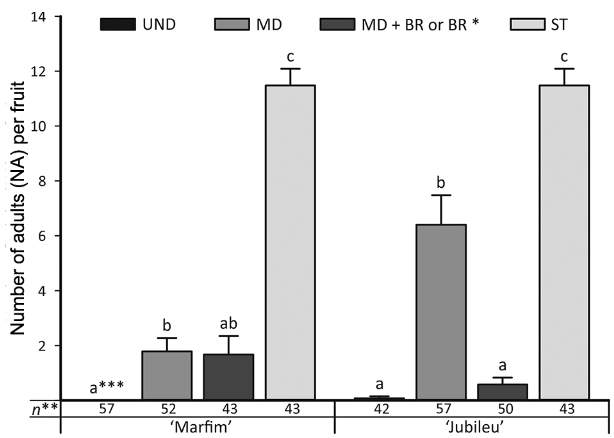

Figure 2 – Number of *Drosophila suzukii* emerged per fruit (mean ± SEM) from peaches with different types of field damages: UND = undamaged; MD = mechanical damage; BR = brown rot disease; ST = strawberry (positive susceptible control); *'Marfim': MD + BR and 'Jubileu': only BR; **Number of replicates; ***Columns followed by the same letter within each cultivar do not differ by the Tukey test at 1 % probability level.

Table 1 – Frequency of natural field infestation of peaches (number of adult flies emerged per fruit) with different damage types for two peach cultivars, in Pelotas, RS, Brazil, during the 2015-2016 crop year.

Treatment[1]	cv. Marfim		cv. Jubileu	
	Z. indianus	Drosophilidae	*Z. indianus*	Drosophilidae
UND	0.00 ± 0.00 a*	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
MD	2.15 ± 0.65 b	3.58 ± 1.54 b	9.40 ± 2.01 b	7.07 ± 1.63 b
BR	1.70 ± 0.60 b	0.00 ± 0.00 a	0.36 ± 0.18 a	0.70 ± 0.32 a
ST	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a

[1]UND = undamaged; MD = mechanical damage; BR = brown rot disease; ST = strawberry (positive susceptible control); *Columns followed by the same letter do not differ by Tukey's test at 1 % probability level.

These results show the importance of the study on *D. suzukii* ecology and the interaction of *D. suzukii* with natural damage in peaches and other non-preferred or non-commercial hosts, not only as a primary pest, but also to understand temporal and spatial fluctuations of the population at the agricultural and natural landscapes, improving our understanding of this species for Integrated Pest Management programs.

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References

Batra, L.R. 1991. World Species of *Monilinia* (fungi): Their Ecology, Biosystematics and Control. J. Cramer Press, Berlin, Germany.

Bellamy, D.E.; Sisterson, M.S.; Walse, S.S. 2013. Quantifying host potentials: indexing postharvest fresh fruits for spotted wing drosophila, *Drosophila suzukii*. Plos One 8: e61227.

Cini, A.; Ioriatti, C.; Anfora, G. 2012. A review of the invasion of *Drosophila suzukii* in Europe and a draft research agenda for integrated pest management. Bulletin of Insectology 65: 149-160.

Dreves, A.J.; Walton, V.; Fisher, G.A. 2009. A new pest attacking healthy ripening fruit in Oregon. Spotted wing drosophila: *Drosophila suzukii* (Matsumura). Available at: http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/13090/em8991.pdf?sequence=3 [Accessed Feb 17, 2016].

Ioriatti, C.; Walton, V.; Dalton, D.; Anfora, G.; Grassi, A.; Maistri, S.; Mazzoni, V. 2015. *Drosophila suzukii* (Diptera: Drosophilidae) and its potential impact to wine grapes during harvest in two cool climate wine grape production regions. Journal of Economic Entomology 108: 1148-1155.

Lichtemberg, P.S.F.; Zeviani, W.M.; Michailides, T.J.; May-De Mio, L.L. 2016. Comparative in vivo and in vitro study on *Monilia fructicola* causing brown rot of stone fruit in Brazil and California. Tropical Plant Pathology 41: 98-106.

Santos, R.S.S. 2014. *Drosophila suzukii* (Matsumura, 1931) (Diptera: Drosophilidae) attacking strawberry fruits in Brazil. Enciclopédia Biosfera 10: 4005-4011 (in Portuguese, with abstract in English).

Walsh, D.B.; Bolda, M.P.; Goodhue, R.E.; Dreves, A.J.; Lee, J.; Bruck, D.J.; Walton, V.M.; O'Neal, S.D.; Zalom, F.G. 2011. *Drosophila suzukii* (Diptera: Drosophilidae): invasive pest of ripening soft fruit expanding its geographic range and damage potential. Journal of Integrated Pest Management 2: G7-G7.