

Occurrence and quantification of *Drosophila suzukii* in the urban area of Vacaria, RS

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Abstract

Drosophila suzukii, also called spotted-wing drosophila (SWD), is a fruit fly which originated in South-eastern Asia. This fly damages small fruits and usually disperses via passive transport in host fruits. Thus, tracking its occurrence is important in that it allows control strategies to be directed to urban areas as well. The purpose of this study was to evaluate the occurrence of *D. suzukii* adults inside and nearby 14 commercial establishments that sell fruits in the urban area of Vacaria, RS, at 2014 and 2016. SWD adults were captured by means of PET bottle traps baited with pure apple vinegar. A total

of 23 flies (15 females and 8 males) and 51 flies (29 females and 22 males) were sampled in 2014 and 2016 respectively. On both occasions, the spotted-wing drosophila was detected in 64.3% of the establishments. In 2016 specifically, 13 females were collected at a sampling point inside a supermarket. The results show that control strategies should take into account the presence of the spotted-wing drosophila in urban areas, especially inside commercial establishments, since this pest may be causing damage to fruits via cross-contamination.

Keywords: Distribution. Fruit Trade. Infestation. Control Strategies. Cross-Contamination.

Resumo

Ocorrência e Quantificação de *Drosophila suzukii* na área urbana de Vacaria, RS

Drosophila suzukii ou SWD é uma mosca das frutas nativa do sudeste da Ásia que danifica pequenos frutos, cuja dispersão é atribuída ao transporte passivo em frutas hospedeiras. O conhecimento sobre a ocorrência de SWD em ambientes urbanos é importante, pois permite que estratégias de controle também sejam direcionadas para as áreas urbanas. Neste contexto, foi avaliada a ocorrência de adultos SWD no entorno e interior de 14 mercados de frutas na área urbana do município de Vacaria, RS, nos anos de 2014 e 2016. Adultos de SWD foram monitorados com armadilhas feitas a partir de garrafas PET com vinagre de maçã puro como atrativo. Um total de 23 (15 fêmeas e 8 machos) e 51 (29 fêmeas e 22 machos) indivíduos foram amostrados em 2014 e 2016, respectivamente. Em ambos os anos, em 64,3 % dos pontos

avaliados houve ocorrência de SWD. Em 2016, num ponto amostral foram coletadas 13 fêmeas no interior do mercado. Os resultados mostram que estratégias de controle para SWD devem levar em conta a sua ocorrência em áreas urbanas, especialmente no interior dos mercados, pois a praga pode estar causando danos nas frutas por infestação cruzada.

Palavras-chave: Distribuição. Comércio De Frutas. Infestação. Estratégia De Controle. Infestação Cruzada.

Introduction

Biological invasions by exotic pest insects have caused worldwide concern due to their negative economic impacts. *Drosophila suzukii* (MATSUMURA, 1931) (Diptera, Drosophilidae), or spotted-wing drosophila (SWD), has spread rapidly across various countries over the last few years (GOODHUE et al., 2011). Unlike other species of the family Drosophilidae, the spotted-wing drosophila is able to oviposit and develop in unwounded ripening soft fruits of a wide range of wild and cultivated plants. Adult females use their serrated ovipositor to cut a slit into healthy fruit to deposit from one to three eggs (LEE et al., 2011). Eggs hatch in as little as 1-3 days and the larvae can complete feeding within several days depending on temperature. SWD adults prefer moderate temperatures and can complete a generation in as little as 8-9 days (TOCHEN et al., 2014). This pest is native to several Asian countries, but has invaded the USA, British Columbia, Italy, France and Spain (HAUSER et al., 2009). After its first reported sighting in Hawaii in 1980, SWD contin-

ued to expand its range across the USA, and an economic loss of \$US100 million was subsequently reported (LEE et al., 2011). In 2014, *D. suzukii* was reported to have attacked strawberry fruits in Brazil, causing crop losses that surpassed 30% in Vacaria, RS (SANTOS, 2014). Vacaria has stood out as an important center for the production of small fruits such as blackberry, raspberry, strawberry and blueberry (POLTRONIERI, 2007), which are all potential hosts for the spotted-wing drosophila. In Brazil, the State of Rio Grande do Sul is considered to be a region whose climate conditions favor the development of the spotted-wing drosophila (by moderate temperature) and, therefore, where the potential economic losses may reach extremely high levels (BENITO et al. 2016).

According to Cini et al. (2014), the South of France may be the starting point of *D. suzukii* in Europe, especially due to the importation of dried fruits such as cherry, grape and strawberry from Southeast Asian countries where the fly originated. Thus, the spread of this pest in Brazil, as well as in other countries in South America, may also be related to the trade of infested fruits. Vilela and Mori (2014) reported the occurrence of the spotted-wing drosophila in blueberries which had originally been grown in the State of Santa Catarina and were traded in the State of São Paulo. Taking into account the passive transport of *D. suzukii* immature forms in host fruits traded in commercial establishments, as well as its rapid life cycle and high proliferation rates, there is a possibility of multiplication and persistence of this pest in the city urban environments throughout the years. Efficient and sustainable solutions to deal with the spotted-wing drosophila require detailed knowledge, i.e., life-story traits, biology and population dynamics. Therefore, this study aimed at analyzing the occurrence of *D. suzukii* in establishments that trade host fruits in Vacaria city, Rio Grande do Sul, Brazil.

Materials and Methods

The experiment was carried out between April and May in 2014 (detection in the town) and 2016 (two years following the first SWD report). Fourteen sampling points near commercial establishments that trade fruits, as well as fairs and animal breeding areas were randomly chosen in the area urban across the town (Table 1). A trap was built from a 250 ml PET bottle with six 0.5mm holes in the lower third of the bottle. The trap was baited with 40 mL of pure apple vinegar, and positioned 1.5 meters above the ground within the crown of a street tree near the sampling point where it remained for 2 days on 4 different sampling occasions in 2014 and 2016. In 2016, 6 commercial establishments consented to have a trap placed for control inside the building (Table 1).

Table 1. Geographical location of the commercial establishments where the traps were installed in order to monitor *Drosophila suzukii* (Matsumura, 1931) (Diptera, Drosophilidae) in the urban area of Vacaria, RS.

Local	Geographical location		Internal trap
A	28°30'9.01"S	050°55'06.60"O	Yes
B	28°38'9.01"S	050°55'44,25"O	Yes
C	28°29'51.7"S	050°56'13.10"O	No
D	28°29'34.7"S	050°56'24.30"O	No
E	28°28'54.3"S	050°57'44.00"O	No
F	28°30'07.0"S	050°57'13.50"O	No
G	28°30'06.8"S	050°56'28.70"O	Yes
H	28°30'25.3"S	050°56'19.60"O	Yes
I	28°30'37.8"S	050°56'30.30"O	Yes
J	28°30'28.3"S	050°56'37.40"O	-

K	28°30'34.7"S	050°56'59.60"O	-
L	28°30'43.2"S	050°56'57.40"O	Yes
M	28°31'20.3"S	050°56'19.40"O	No
N	28°29'39.6"S	050°55'26.90"O	No

The same procedure was adopted for outdoor traps, except for the fact that the traps had to be slightly adapted so that they could be attached to fruit stalls. Traps were not installed in internal points of 'municipal market fair' (J) and 'dairy cattle breeding' (K), because they are open-air places. Captured flies were analyzed through a stereomicroscope at the Entomology Laboratory of Embrapa Uva e Vinho so that sexing and quantity of SWD adults could be determined. The identification of the spotted-wing *Drosophila* was based on the sexually dimorphic wing pattern, male foreleg sex combs, male and female terminalia (BOCK; WHEELER, 1972). Data regarding capture in sampling points were integrated into a map of the town in order to indicate the urban areas affected by the fly.

Results and Discussion

In 2014, *D. suzukii* adults were detected in 9 out of 14 sampling points (64.3%). Two years later, the same percentage was obtained. However, the fly was no longer detected in two points, namely local A and I. On the other hand, two points that had no SWD reports in 2014, namely local F and G, registered the presence of the fly in 2016. In the following establishments, namely local E, H and N, the species was neither detected in 2014 nor in 2016 (Table 2). The population analysis carried out in 2014 revealed that there were eight males and 15 females out of 23 captured flies. In 2016, however, the

incidence increased to 51 flies, of which 22 were males and 29 females. As the results show, two years later the detection of SWD in the town, its population increased 120%. The results are concern, since they show the pest has settled in the urban area. In 2014, the local B was the sampling point that registered the highest occurrence of the species (3 ♂ + 4 ♀), while, in 2016, this place was attributed to dairy cattle breeding (local K) (4 ♂ + 13 ♀) (Table 2). In 2016, data regarding indoor control revealed the presence of the spotted-wing drosophila in a sampling point, namely local L, where 13 females were caught. The SWD was also detected outside this establishment in 2014 as well as in 2016 (Table 2). Therefore, the detection of the species inside and outside commercial establishments selling host fruits reinforces the idea that trading fruits infested with eggs and/or larvae is indeed an important means by which this pest is disseminated, as Schlesener et al. (2014) suggest. As SWD can attack either intact fruits as well as fallen damaged ones (DREVES; LANGELLOTTO-RHODABACK, 2011), fruit residues from commercial establishments may have allowed the species to proliferate in the urban area. That may partially explains the presence of the pest in dairy cattle breeding points (Table 1), since the animals were fed with varied plant residues collected in the town, and there weren't any plantations of fruits considered potential hosts for the spotted-wing drosophila in the area.

Table 2. Number of *Drosophila suzukii* (Matsumura, 1931) (Diptera, Drosophilidae) adults captured with traps in different commercial points.

Local	4/28/14		5/5/14		5/12/14		5/19/14		2014	4/18/16		4/25/16		5/2/16		5/9/16		2016	
	Male	Female	Male	Female	Male	Female	Male	Female	Total	Male	Female	Male	Female	Male	Female	Male	Female	Total	
A	0	1	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
B	3	1	0	1	0	0	2	0	7	1	0	0	0	1	5	2	0	9	
C	0	1	0	2	0	0	0	0	3	0	0	1	2	3	0	1	0	7	
D	0	1	0	0	0	0	0	0	1	0	0	1	0	1	1	0	1	4	
E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
F	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	
G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	
H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
I	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	
J	0	0	0	1	0	0	0	0	1	0	0	1	0	4	0	0	0	5	
K	0	0	0	0	1	0	1	0	2	2	1	1	0	0	3	1	9	17	
L	0	1	0	0	1	0	0	0	2	0	0	0	2	1	0	0	2	5	
M	0	2	0	1	0	0	0	0	3	0	0	0	0	0	0	0	2	2	
N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total	3	7	0	7	2	0	3	1	23	3	1	4	5	10	9	5	14	51	

As the results also show, even though local E is located near an area where small fruits are grown (around 500m) and attacks had already occurred (SANTOS et al., 2016), no SWD were detected by our controls during sampling periods. This result reinforces that the passive diffusion of this fly through infested fruits is the most common means by which the species disseminates. For instance, Cini et al. (2014) point out that the importation of fruits infested with young

D. suzukii from Asia may have been the cause of the invasion of this pest in Europe. The occurrence of immature species in fruits commercialized in São Paulo, Brazil, was reported by Vilela and Mori (2014). We show occurrences of the spotted-wing drosophila adults inside and outside fruit shops reaching an extensive area across the town (Figure 1). Taking into account that this pest reproduces rapidly, i.e. adults become sexually active only two days after their emergence and attack a wide range of plants (CINI et al., 2012), the detection of female adults inside a commercial establishment is cause for concern. These findings suggest that fresh fruits may be damaged inside establishments, thus reducing their shelf life as well as home conservation.

This process is called cross-contamination in grain merchandising, i.e. sound grains from the field may be infested by pest in commercial establishments when preventive measures are not taken (GALLO et al., 2002). Thus, our findings show the need for orientation and conscientization of shop owners as well as an integrated management plan so as to reduce the reproduction of *D. suzukii* inside and outside commercial establishments. As an example it is necessary to clean the market and treat host fruit residues (solarization or freezing) before they are discarded. Besides, monitoring and control strategies will have to be developed in order to manage the populations of spotted-wing drosophila inside commercial establishments that trade potential host fruits.



Figure 2. Distribution of sampling points where the species was detected. Commercial establishments where the fly was detected are shown in red (A; B; C; D; E; F; G; H; I; J and K). Commercial establishments with no occurrences are shown in blue (E; H and N).

Conclusion

Drosophila suzukii is widely spread in the surroundings of establishments that sell host fruits for the species in Vacaria, RS. In addition, spotted-wing drosophila adults are found inside some shops, which suggests that the fly may be attacking fruits indoors.

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