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Estudio de potenciales parasitoides (Hymenoptera) de
Drosophila suzukii (Diptera: Drosophilidae) en la provincia
de Buenos Aires, Argentina

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Abstract: *Drosophila suzukii* (Matsumura) is a pest that affects a great variety of fruit crops. The objective of this work was to learn about the diversity of parasitoids (Hymenoptera) that might be associated with SWD in fruit crops located in northeastern Buenos Aires province, Argentina. Species were identified as *Euxestophaga argentinensis* Gallardo, *Ganaspis pelleranoi* (Brèthes), *Leptopilina boulandi* (Barbotin, Carton & Kelner-Pillault), *Hexacola bonaerensis* Reche (Cynipoidea, Figitidae), *Trichopria anastrephae* (Costa Lima) (Diaprioidea, Diapriidae) and *Pachycrepoideus vindemmiae* (Rondani) (Chalcidoidea, Pteromalidae). *Leptopilina boulandi*, *E. argentinensis* and *T. anastrephae* were reported for the first time in the Buenos Aires province.

Keywords: Fruit crops, Parasitoids, Pampean biogeographic province, Spotted-wing *Drosophila*.

Resumen: *Drosophila suzukii* (Matsumura) es una plaga que afecta a una gran variedad de cultivos frutales. El objetivo de este trabajo fue conocer la diversidad de parasitoides (Hymenoptera) que podrían estar asociados con SWD en cultivos frutales ubicados en el noreste de la provincia de Buenos Aires, Argentina. Las especies identificadas fueron *Euxestophaga argentinensis* Gallardo, *Ganaspis pelleranoi* (Brèthes), *Leptopilina boulandi* (Barbotin, Carton & Kelner-Pillault), *Hexacola bonaerensis* Reche (Cynipoidea, Figitidae), *Trichopria anastrephae* (Costa Lima) (Diaprioidea, Diapriidae) y *Pachycrepoideus vindemmiae* (Rondani) (Chalcidoidea, Pteromalidae). Se registró por primera vez a *L. boulandi*, *E. argentinensis* y *T. anastrephae* en la provincia de Buenos Aires.

Palabras clave: Cultivos frutales, *Drosophila* de alas manchadas, Parasitoides, Provincia biogeográfica Pampeana.

Drosophila suzukii (Matsumura), commonly known as spotted wing drosophila (SWD) is a pest that affects a great variety of fruit crops (Cini et al., 2012). SWD female oviposits under the skin of healthy and mature fruit by piercing the epicarp with a serrated ovipositor. This fact together with softening due to the larval activity, exposes fruits to different pathogens, leading to their decay and the consequent economic losses (Cini et al., 2012). Despite SWD is native to Southeast Asia, it has been recently registered in the European and American continents as a result of its high dispersion capacity (Bolda et al., 2010; Calabria et al., 2012). In Argentina, SWD was detected for the first time in 2014 in raspberry crops of the province of Río Negro (Cichón et al., 2015). Almost simultaneously, it was reported in blueberry crops from the province of Buenos Aires (Santadino et al., 2015) and traps located in orange plantations in Entre Ríos (Díaz et al., 2015). Thereafter, SWD was recorded from different fruit-producing regions, such as NOA (Lue et al., 2017; Funes et al., 2018; Lavagnino et al., 2018), Cuyo (Dagatti et al., 2018), Patagonia (Garrido et al., 2018; Lavagnino et al., 2018; de la Vega et al., 2019), NEA (SENASA, 2016) and Pampeana (Gonsebatt et al., 2017; Lavagnino et al., 2018). To date, there are no registered chemical products for SWD control in Argentina, being cultural and biological control two of the main tools for its management (Escudero-Colomar, 2016). In this context, the search for potential natural enemies of this pest is essential for integrated control programs (García, 2020; Wang et al., 2020). A recent worldwide review of SWD natural enemy species was published by Kirschbaum et al. (2020).

Parasitoids were the most numerous and most studied group of SWD's natural enemies. The known species of parasitoid wasps that attack *D. suzukii* belong to five genera. Two of them are pupal parasitoids, namely, *Pachycrepoideus* Ashmead (Chalcidoidea, Pteromalidae) and *Trichopria* Ashmead (Diaprioidea, Diapriidae), and the remaining three are larval parasitoids: *Leptopilina* Förster, *Ganaspis* Förster (Cynipoidea, Figitidae) and *Asobara* Förster (Ichneumonoidea, Braconidae) (Asplen et al., 2015). Species of the genus *Ganaspis* are among the most efficient SWD parasitoids, showing the highest rates of parasitoidism (Cini et al., 2012). In this sense, Giorgini et al. (2019) suggested that *Ganaspis brasiliensis* (von Ihering) was a promising classical biological control agent for release in invaded regions because of its demonstrated high specificity. Recent studies in Argentina are encouraging, since they have reported *G. brasiliensis* (Gallardo et al., 2021), *Ganaspis hookeri* Crawford (Lue et al., 2017), *Leptopilina boulandi* (Barbotin, Carton & Kelner-Pillault) (Garrido et al., 2018), *Leptopilina clavipes* (Hartig) (Lue et al., 2017), *Pachycrepoideus vindemmiae* (Rondani) (Funes et al., 2020), *Spalangia endius* Walker (Gómez Segade et al., 2021) and more recently a new species of *Dieucoila* Ashmead, *D. octoflagella* Reche (Reche et al., 2021) in association with SWD. Thus, the objective of this work was to find out the diversity of parasitoids that might be associated with SWD in fruit crops located in northeastern Buenos Aires province, Argentina.

The study was conducted in fruit orchards in three localities: Luján (34° 35' S; 59° 04' W), Lobos (35° 11' S; 59° 16' W) and Mercedes (34° 41' S; 59° 24' W). Samplings were carried out during 2017 and 2018 in SWD-infested crops of strawberries, blueberries, raspberries, cherries, peaches and blackberries. The specimens were captured using traps baited with 200 cc of apple vinegar diluted to 50% with water. Traps were placed in the central part of each fruit crop along the windbreaks and were renewed every fifteen days. The material collected was taken to the laboratory to count adult SWD and potential parasitoids. Fruit samples with no evident fruit damage collected from the field during the harvest period. In the laboratory, each fruit was individually placed in ventilated containers inside a GC-300 growth chamber (Lab. Companion®) under controlled conditions (23 ± 2 ° C, Relative humidity 60 ± 10%, Photoperiod 16L: 8D), until adult emergence. The proportion of infested fruit and the number of adults were used to estimate Incidence and Severity.

The wasp specimens recovered (n = 26) were sent for identification to the Sección Hymenoptera Parasítica of the División Entomología, Museo de La Plata, Buenos Aires, Argentina. The specimens were identified using taxonomic keys (Risbec, 1950; Gibson, et al., 1997; Guimarães et al., 2003) and specialized bibliography. The dipterans specimens were identified using taxonomic keys (Vlach, 2010). The wasp specimens examined were deposited in the entomological collection of the Museo de La Plata.

The number of SWD and adult wasps recovered per crop sample is summarized in Table I. Besides documenting *Drosophila suzukii*, six species of Hymenoptera parasitoids belonging to Figitidae, Diapriidae

and Pteromalidae were also collected: *Euxestophaga argentinensis* Gallardo, *Ganaspis pelleranoi* (Brèthes), *L. bouldardi*, *Hexacola bonaerensis* Reche (Cynipoidea, Figitidae), *Trichopria anastrephae* (Costa Lima) (Diaprioidea, Diapriidae) and *P. vindemmiae* (Chalcidoidea, Pteromalidae). Fruit infestation was variable between species and no parasitoids were recorded (Table II).

Locality	Crop	<i>D. suzukii</i>	<i>E. argentinensis</i>	<i>G. pelleranoi</i>	<i>H. bonaerensis</i>	<i>L. bouldardi</i>	<i>T. anastrephae</i>	<i>P. vindemmiae</i>
Lobos	Cherry	246			3 females	1 female		1 female
	Raspberry	31				1 female		
	Blueberry	171				2 females		
Luján	Strawberry	5					1 female	
	Blackberry	51		3 females		1 female	1 female	
	<i>Morus spp.</i>	134				1 female	1 male	
	Peach	5	1 female	1 female			1 female	
	<i>Morus spp.</i>	3				4 females		
Mercedes	Blackberry	22		1 female	1 female			

Table I. Total number of captures of female and male *Drosophila suzukii* and wasps from June 2017 to June 2018.

Locality	Crop	Incidence (%)	Severity (flies per fruit)
Lobos	Cherry	3	0,03
	Raspberry	44	2,38
	Blueberry	0	0
Luján	Strawberry	11	0,35
	Blackberry	40	2,17
	<i>Morus spp.</i>	21	1,24
	Peach	3	0,07
Mercedes	<i>Morus spp.</i>	0	0
	Blackberry	14	0,29

Table II. Mean of Incidence (% of fruit damaged) and Severity (mean flies developed per fruit) of damage of *Drosophila suzukii*

Euxestophaga argentinensis Gallardo

Distribution. Neotropical region. Argentina. It is distributed throughout the provinces of Santa Fe, Tucumán (Gallardo et al., 2017), and Buenos Aires (new record).

Biology. Primary larval-pupal solitary koinobiont endoparasitoids of Diptera Otitidae: *Euxesta eluta* Loew (Gallardo et al., 2017).

Material examined. Argentina. Buenos Aires. Luján. 1 female, crop of *Prunus persica* (Rosaceae) (peaches), experimental field UNLu, 15-XI-2017, Dettler coll.

Ganaspis pelleranoi (Brèthes)

Distribution. Neotropical region: Mexico, Belize, Guatemala, El Salvador, Costa Rica, Panama, Colombia, Venezuela, Brazil, Peru, Bolivia and Argentina (Díaz & Gallardo 2001). In Argentina, it is distributed throughout the provinces of Buenos Aires, Corrientes, Jujuy, Misiones, Salta, Tucumán (Díaz & Gallardo, 2014) and La Rioja, (Nuñez-Campero & Ovruski, 2013).

Biology. Primary larval-pupal solitary koinobiont endoparasitoid of Diptera Tephritidae: *Anastrepha fraterculus*, *Anastrepha schultzi*, *Anastrepha* sp., *Ceratitis capitata*, and Lonchaeidae: *Lonchaea* sp. (Guimarães et al., 2003; Díaz & Gallardo, 2014).

Material examined. Argentina. Buenos Aires. Luján. 1 female, crop of *Prunus persica* (Rosaceae) (peaches), experimental field UNLu, 18-I-2018, Ansa coll.; 2 females, crop of *Rubus ulmifolius* (Rosaceae) (blackberries), experimental field UNLu, 26-XII-2017, Ansa coll.; 1 female, crop of *Rubus ulmifolius* (Rosaceae) (blackberries), experimental field UNLu, 18-I-2018, Ansa coll. **Mercedes.** 1 female, crop of *Rubus ulmifolius* (Rosaceae) (blackberries), family farm, 06-XI-2017, Riquelme Virgala coll.

Hexacola bonaerensis Reche

Distribution. Nearctic and Neotropical regions: US, Cuba and Argentina, where it is distributed throughout the province of Buenos Aires (Reche & Gallardo, 2015).

Biology. Primary larval-pupal solitary koinobiont endoparasitoid of Diptera Ephydriidae (Reche & Gallardo, 2015).

Material examined. Argentina. Buenos Aires. Lobos. 2 females, crop of *Prunus avium* (Rosaceae) (cherries), commercial field, 15-V-2018, Dettler coll.; 1 female, crop of *Prunus avium* (Rosaceae) (cherries), commercial field, 21-VI-2018, Dettler coll. **Mercedes.** 1 female, crop of *Rubus ulmifolius* (Rosaceae) (blackberries), family farm, 8-I-2018, Dettler coll.

Leptopilina boulardi (Barbotin, Carton & Kelner-Pillault)

Distribution. Cosmopolitan. In Argentina, it has been reported in the provinces of Tucumán (Díaz & Gallardo, 2014), Neuquén, Río Negro (Garrido et al., 2018) and Buenos Aires (new record).

Biology. Primary larval-pupal solitary koinobiont endoparasitoid of Diptera Drosophilidae: *Drosophila melanogaster* (Nordlander, 1980), *Zaprionus indianus* (Marchiori et al., 2003), *Drosophila suzukii* (Cuch-Arguimbau et al., 2013; García Cancino et al., 2015; Wollmann et al., 2016; Knoll et al., 2017; Garrido et al., 2018).

Material examined. Argentina. Buenos Aires. Lobos. 1 female, crop of *Prunus avium* (Rosaceae) (cherries), commercial field, 8-I-2018, Dettler coll.; 1 female, crop of *Rubus idaeus* (Rosaceae) (raspberries), commercial field, 8-I-2018, Dettler coll.; 1 female, crop of *Vaccinium corymbosum* (Ericaceae) (blueberries), commercial field, 8-I-2018, Dettler coll.; 1 female, crop of *Vaccinium corymbosum* (Ericaceae) (blueberries), commercial field, 21-VI-2017, Dettler coll. **Luján.** 1 female, crop of *Morus* spp. (Moraceae), experimental field UNLu, 26-XII-2017, Ansa coll.; 1 female, crop of *Rubus ulmifolius* (Rosaceae) (blackberries), experimental field UNLu, 26-XII-2017, Ansa coll. **Mercedes.** 1 female, windbreak of *Morus* spp. (Moraceae), family farm, 06-XI-2017, Dettler coll.; 3 females, windbreak of *Morus* spp. (Moraceae), family farm, 15-V-2018, Dettler coll.

Trichopria anastrephae (Costa Lima)

Distribution. Neotropical region: Brazil (Costa Lima, 1940), Argentina (Turica & Mallo 1961) and Venezuela (Boscán & Godoy, 1996). In Argentina, this species is distributed throughout the provinces of Tucumán (Turica & Mallo, 1961) and Buenos Aires (new record).

Biology. Primary pupal solitary idiobiont endoparasitoid of Diptera Tephritidae: *Anastrepha* sp., *A. serpentine* (Costa Lima, 1940), *Anastrepha fraterculus*, *Ceratitis capitata* (Ovruski et al., 2006); Drosophilidae: *Drosophila* spp. (Turica & Mallo, 1961) and *D. suzukii* (Wollmann et al., 2016).

Material examined. Argentina. Buenos Aires. Luján, 1 female, crop of *Fragaria x ananassa* (Rosaceae) (strawberries), commercial field, 27-XII-2017, Martínez coll.; 1 female and 1 male, crop of *Rubus ulmifolius* (Rosaceae) (blackberries), experimental field UNLu, 18-I-2018, Ansa coll.; 1 female, windbreak of *Morus* spp. (Moraceae), experimental field UNLu, 26-XII-2017, Ansa coll.; 1 female, crop of *Prunus persica* (Rosaceae) (peaches), experimental field UNLu, 06-XI-2017, Dettler coll.

Pachycrepoides vindemmiae (Rondani)

Distribution. Cosmopolitan. In Argentina, it is distributed throughout the provinces of Córdoba (Fischetti et al., 1978), Tucumán (Nasca, 1976), Mendoza (De Santis, 1960), Catamarca (De Santis & Gallego de Sureda, 1988), Buenos Aires, Entre Ríos (Turica et al., 1971) and La Rioja (Ovruski, 2002).

Biology. Polyphagous pupal ectoparasitoid of various families of Diptera Muscomorpha although its members are primary parasitoids, they can also develop as facultative hyperparasitoids (Van Alphen & Thunnissen, 1983; Wang & Messing, 2004). A wide range of hosts from diverse families of dipterous have been recorded: Anthomyiidae, Calliphoridae, Cecidomyiidae, Drosophilidae, Lonchaeidae, Muscidae, Phoridae, Piophilidae, Sarcophagidae, Sphaeroceridae, Stratiomyiidae, Syrphidae and Tephritidae (Noyes, 2019).

Material examined. Argentina. Buenos Aires. Lobos. 1 female, crop of cherries, *Prunus avium* (Rosaceae), commercial field, 27-XI-2017, Vazquez coll.

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