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Presence of Drosophilidae (Diptera: Ephydroidea) flies associated with fig fruits in Morelos, Mexico

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In Mexico, figs (*Ficus carica* L.; Moraceae) traditionally have been produced mostly in family gardens for home consumption, with negligible commercialization of fig production (Macías-Rodríguez et al. 2015). Today, demand for this fruit has increased, particularly because of the proximity of foreign markets such as the United States and Canada, causing an increase in the area of fig cultivation. According to the Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA) (2015), the principal fig-growing states are Morelos, Baja California Sur, Puebla, and Hidalgo, which produce an estimated 6,000 tons, with a production value of about 48.8 million pesos (US \$2.6 million).

In the state of Morelos, the variety Netzahualcoyotl has become important for growers because of its parthenocarpic fruits, which do not need pollinating insects, and it is cultivated intensively in greenhouses. One of the advantages of this production system is the decrease of insect pest attack on the crop, resulting in lower management costs. However, fig growers in the state of Morelos report premature fruit rotting that has increased over time.

Because of this, during the months of Sep and Dec 2016, in the municipality of Temoac, Morelos, ripe and overripe fruits were collected in commercial plantings (18.7724 °N, 98.7932 °W, 1564 masl) of Netzahualcoyotl fig in greenhouses. The fruits were confined individually in 1 L polyethylene containers (9 cm lower diam, 12 cm upper diam, 14 cm height) covered with organza fabric, and taken to the agricultural entomology laboratory of the Colegio de Postgraduados Campus Montecillo, Montecillo, Texcoco, Estado de México, México. The adult insects that emerged were identified using the keys of McAlpine (1981), Markow and O'Grady (2006) and Yassin and David (2010).

A total of 1,313 adult flies of the family Drosophilidae (Diptera) was collected. The species identified were African fig fly, *Zaprionus indianus* Gupta (n = 1,024) (Fig. 1A and 1B), spotted wing drosophila, *Drosophila suzukii* Matsumura (n = 31) (Fig. 1C and 1D), and vinegar fly, *Drosophila melanogaster* Meigen (n = 258) (Fig. 1E and 1F). Adults of *Z. indianus* emerged from ripe and overripe fruits, whereas *D. suzukii* and *D. melanogaster* emerged only from overripe fruits, and so are considered secondary or opportunistic.

Zaprionus indianus is native to the sub-Saharan region of Africa (van der Linde et al. 2006), where it is not considered a major pest.

In the Americas, the first report of this species in fig fruits was in São Paulo, Brazil (Vilela et al. 1999), where it caused production losses of 40 to 50%, and where it was given the name African fig fly (Stein et al. 2003; Svedese et al. 2012). In Mexico, this dipteran was detected for the first time in 2002 in the state of Chiapas. Later, it was reported in the states of Michoacán, State of México, Sinaloa, Sonora, Baja California Sur, Oaxaca, Nayarit, Sonora, Guanajuato, Querétaro, and Veracruz (Castrezana 2007; Markow et al. 2014; Lasa & Tadeo 2015). This paper is the first report of the presence of this species in fig fruit in Morelos.

Adult flies of the genus *Zaprionus* are generally easily distinguished by the presence of a pair of white or silver longitudinal bands from the head to the back edge of the scutellum (Fig. 1B) and another pair of lateral bands on the sides of the pronotum (Yassin & David 2010).

The females oviposit on the edge of the ostioles (Fig. 2A) of fruits of different states of maturity (Fig. 2B) or directly inside of them. *Zaprionus indianus* eggs are characterized by the presence of 4 respiratory appendages, unlike *Drosophila* species, which have only 2 (Fig. 2C). We observed that the flies enter and exit constantly through this natural opening in the fig, suggesting that it is done for the purposes of feeding and refuge.

Drosophila melanogaster has a cosmopolitan distribution, and it is believed that this species originated in the African tropics (Lachaise et al. 1988; David & Capy 1988). The larvae of this species are associated principally with decomposing plant material. Cha et al. (2014) mentions that the adults are attracted by volatile compounds released by fermentation of the fruits.

Drosophila suzukii is an endemic to Southeast Asia and is considered an invasive pest in most areas of the world (Walsh et al. 2011). Unlike other species of the genus, the females can oviposit in healthy ripe fruits, and possess a serrated ovipositor with which they cause physical damage to the host (Hauser 2011; Walsh et al. 2011). Until now, there have been no reports of this species in fig fruits in Mexico.

According to our observations, *Z. indianus* is a major pest of fig plantations of the area because of the damage it causes to the fruits, and its potential to disrupt commercialization of fig fruit. *Drosophila susukii* and *D. melanogaster*, however, were opportunistic.

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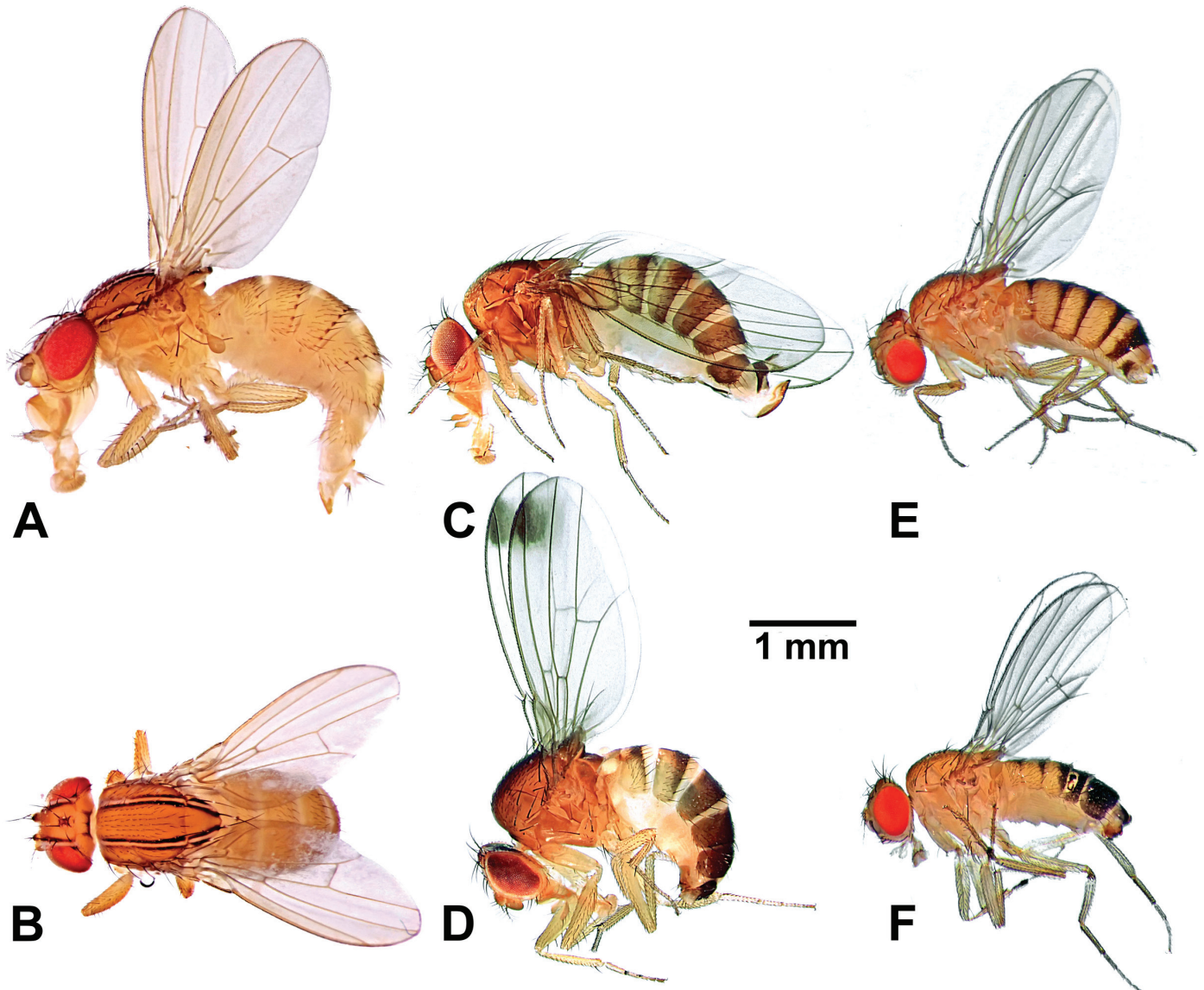


Fig. 1. Drosophilidae associated with fig fruits. *Zaprionus indianus*, (A) female and (B) male; *Drosophila suzukii* (C) female and (D) male; *Drosophila melanogaster* (E) female and (F) male.

tic insects, probably attracted by the volatiles released by overripe fruits, and may take advantage of free access through the ostiole and damage on the epidermis.

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Summary

The presence of *Zaprionus indianus*, *Drosophila suzukii*, and *Drosophila melanogaster* (Diptera: Drosophilidae) in Nezhualc6yotl var. fig fruits is reported in commercial greenhouse plantations in the state of Morelos, Mexico. The area planted with fig has been increasing in

this region, due to the opening of new markets; therefore, these pests represent a phytosanitary problem for the crop. The adults of *Z. indianus* emerged from ripe and overripe fig fruits, whereas the other 2 species only from overripe fruits.

Key words: African fig fly; spotted wing drosophila; vinegar fly; *Ficus carica*

Sumario

En el presente estudio, se reporta la presencia de *Zaprionus indianus*, *Drosophila suzukii* y *Drosophila melanogaster* (Diptera: Drosophilidae) en frutos de higo variedad Nezhualc6yotl en plantaciones comerciales cultivadas en invernadero, en el estado de Morelos, M6xico. La superficie sembrada de higo se ha incrementado en esta regi6n debido a la apertura de nuevos mercados, por lo que estas plagas representan un problema fitosanitario para el cultivo. Los adultos de *Z.*

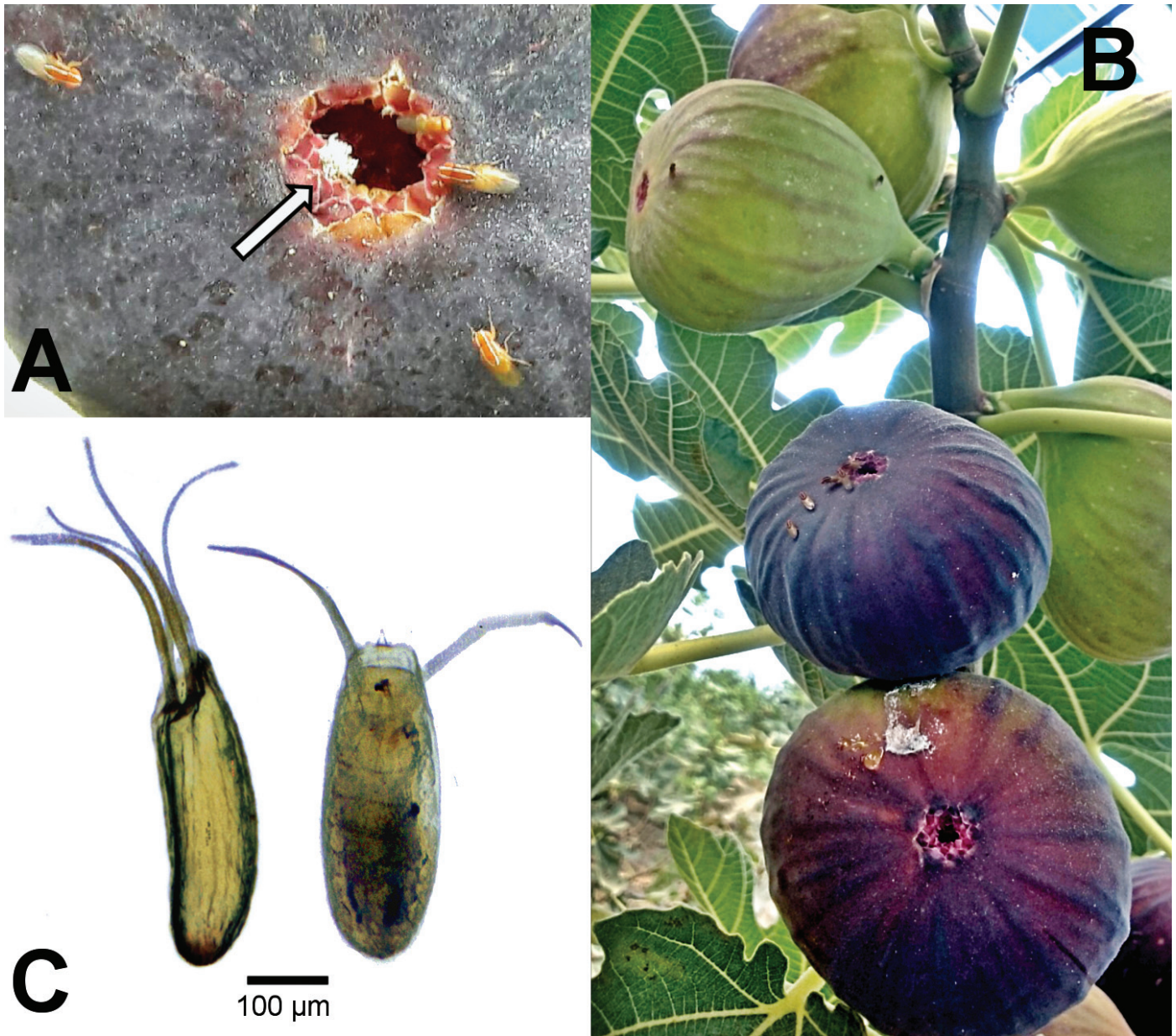


Fig 2. *Zaprionus indianus* on fig fruits. (A) Oviposition of *Zaprionus indianus*; (B) fig fruits susceptible to *Z. indianus*; (C) *Z. indianus* (left) and *Drosophila melanogaster* (right) eggs. The arrow in Fig 2A points to eggs at the entrance of the ostiole.

indianus emergieron de frutos de higo en varios estados de madurez y las otras 2 especies únicamente de frutos sobremaduros.

Palabras Clave: Mosca africana del higo; mosca del vinagre de alas manchadas; mosca del vinagre; *Ficus carica*

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