Colegio de Postgraduados

First record of *Zaprionus indianus* Gupta, 1970 (Diptera: Drosophilidae) in peach crops in the community of Surutato, Badiraguato, Sinaloa, Mexico

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ABSTRACT

Objective: To identify the dipteran species associated with premature peach fruit drop in the community of Surutato, thereby providing a foundation for the development of phytosanitary measures.

Design/methodology/approach: McPhail-type traps baited with hydrolyzed protein as an olfactory attractant were installed in peach plants (*Prunus persica* L. Batsch, 1801). The collected specimens were preserved in 70% ethanol and subsequently identified using dichotomous keys.

Results: Six morphotypes belonging to the order Diptera were identified: three syrphids (Syrphidae), one phorid (Phoridae), one muscid (Muscidae), and one drosophilid (Drosophilidae). The first five are characterized as predators of aphids and psyllids. The identified drosophilid was the African fig fly (*Zaprionus indianus* Gupta, 1970), a pest that, over the past three decades, has demonstrated remarkable invasive capacity across the American continent.

Limitations on study/implications: Sampling was limited to the community of Surutato and to peach plants; consequently, the true extent of the infestation remains unknown, as does the presence of the African fig fly in other crops.

Findings/conclusions: This study presents the first record of the African fig fly, *Zaprionus indianus* Gupta, 1970 (Diptera: Drosophilidae), at 1,500 metres above sea level in peach cultivation in the state of Sinaloa. The data suggest that the pronounced phenotypic plasticity exhibited by the African fig fly, together with its considerable tolerance to low temperatures and the availability of host plants, confers the necessary attributes for its successful establishment in the Sierra de Surutato.

Keywords: Diptera, African fig fly, invasive species, *Prunus persica*.

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INTRODUCTION

Peach production (*Prunus persica* L.) in Mexico is carried out under both irrigated and rainfed systems. In 2024, total production reached 265,227.44 tonnes, with a production value of $3,071,067.32. The principal producing states are Zacatecas (92,422.86 t), Chihuahua (37,062.35 t), and Michoacán (31,560.58 t). Sinaloa contributed 846.05 tonnes,

equivalent to 0.31% of national production, with a value of $11,942.98 (SIAP, 2024). The commercial quality of peach fruit is affected by the attack of various arthropod pests. Among these, insects with chewing mouthparts (Orthoptera), piercing-sucking mouthparts (Hemiptera), rasping mouthparts (Thysanoptera), and boring or ovipositing habits, such as weevils (Coleoptera) and flies (Diptera), are particularly noteworthy (Campbell *et al.*, 2021). Fruit flies are regarded as among the most destructive pests worldwide in horticultural systems, including fruit and vegetable crops (El-Maghraby *et al.*, 2023). The African fig fly (*Zaprionus indianus* Gupta) is an invasive generalist species native to tropical Africa that has spread to the Americas, Europe, and the Middle East over recent decades (Cruz-Esteban, 2021; Franco-Valbuena *et al.*, 2025; Lasa & Tadeo, 2015; Rakes *et al.*, 2023). It was first detected in Brazil in 1999 in commercial fig crops and was subsequently reported in the United States and Canada (Rakes *et al.*, 2023). In Mexico, this dipteran was first detected in the state of Chiapas in 2002 (Domínguez-Monge *et al.*, 2020), and was later recorded in Sonora, Guanajuato, Querétaro, and Oaxaca (Lasa & Tadeo, 2015), Michoacán (Cruz-Esteban, 2021), Morelos (Franco-Valbuena *et al.*, 2025), and Veracruz (Flores-Sánchez *et al.*, 2024; Lasa & Tadeo, 2015; Lasa *et al.*, 2017). In Sinaloa, it was identified in fig crops in the community of Corerepe, Guasave, which is characterized by a BW (dry-hot) climate, temperatures ranging from 18 to 30 °C, and an altitude of 11 metres above sea level (Ruiz-Ramírez *et al.*, 2025). The African fig fly lays its eggs in the ostioles or lenticels of fruits at the onset of ripening, rendering them unsuitable for consumption and processing. Nevertheless, when the fig production season declines, the fly shifts to other host species (Pasini *et al.*, 2014), including guava (Lasa & Tadeo, 2015; Lasa *et al.*, 2017), plums, oranges, berries (strawberries, blackberries, dewberries, and raspberries), and peaches (Cruz-Esteban, 2021; Franco-Valbuena *et al.*, 2025). It is considered a primary pest when it affects fruits still attached to the tree, and a secondary pest when it develops in fallen fruits undergoing decomposition, feeding on bacteria and yeasts associated with the fermentation of carbohydrate-rich substrates. In the community of Surutato, located in the municipality of Badiraguato, Sinaloa, Mexico, peach is the principal fruit crop of the region. Its fruits are marketed both fresh and processed (in syrup, candied, as jams, and as milk caramel), representing an essential source of income for producing families. However, in recent years, growers have repeatedly reported premature fruit drop, which significantly reduces both yield and the commercial quality of the harvest. Despite the economic importance of this problem, the causal agent responsible has not been identified, thereby hindering the design and implementation of effective integrated management strategies. As a result, many growers have been compelled to supplement or even replace their local production by purchasing fruit from other states in order to sustain their commercial activity. In this context, the aim of the present study was to identify the dipteran associated with premature peach fruit drop in Surutato, with the aim of generating scientific knowledge that may serve as a basis for the development of future control measures.

MATERIALS AND METHODS

The present study was descriptive in nature. Sampling was conducted in the community of Surutato, municipality of Badiraguato, Sinaloa, Mexico (25° 47′08” N, 107° 33′20”

W), located between 1,400 and 1,600 metres above sea level (Figure 1). The area is characterized by a temperate subhumid climate (García, 1998), with vegetation dominated by mixed pine (*Pinus* spp.) and oak (*Quercus* spp.) forests. Dipterans were captured using McPhail-type traps baited with hydrolyzed protein as an olfactory attractant (Villalobos-Moreno *et al.*, 2020). The traps were installed in peach trees, *P. persica*, for seven days, following the technical recommendations of the State Plant Health Committee of Sinaloa (Comité Estatal de Sanidad Vegetal de Sinaloa, CESAVESIN), particularly with respect to the dosage and preparation of the attractant.

The specimens were examined using an INSKAM digital stereomicroscope and subsequently identified through the dichotomous keys proposed by Yuzuki and Tidon (2020) and Miranda *et al.* (2013). All samples were permanently preserved in 70% ethyl alcohol and stored in vials labeled with collection data, including developmental stage (adult/larva), date, locality, site, coordinates, host, temperature, and collector.

RESULTS AND DISCUSSION

Six morphotypes belonging to the order Diptera were identified (Table 1). Identification was carried out to the family or genus level using dichotomous keys, making it possible to determine that the principal morphospecies present belonged to four families. Three syrphid morphospecies (Syrphidae) were identified: *Allograpta* sp. Osten Sacken, 1875, and *Sphaerophoria* sp. Le Peletier & Serville, 1825, together with one phorid morphotype (Phoridae), one muscid morphotype (Muscidae), and one drosophilid species: the African fig fly. These morphospecies are readily distinguishable under a binocular lens or microscope because of their contrasting external morphology, as similarly reported in studies of dipterans associated with crops (Navarro *et al.*, 2000), in which features such as body size, body coloration, thoracic shape, and wing patterns are emphasized for classification. Adult Phoridae are small flies, with body lengths ranging from 0.5 to 6 mm.

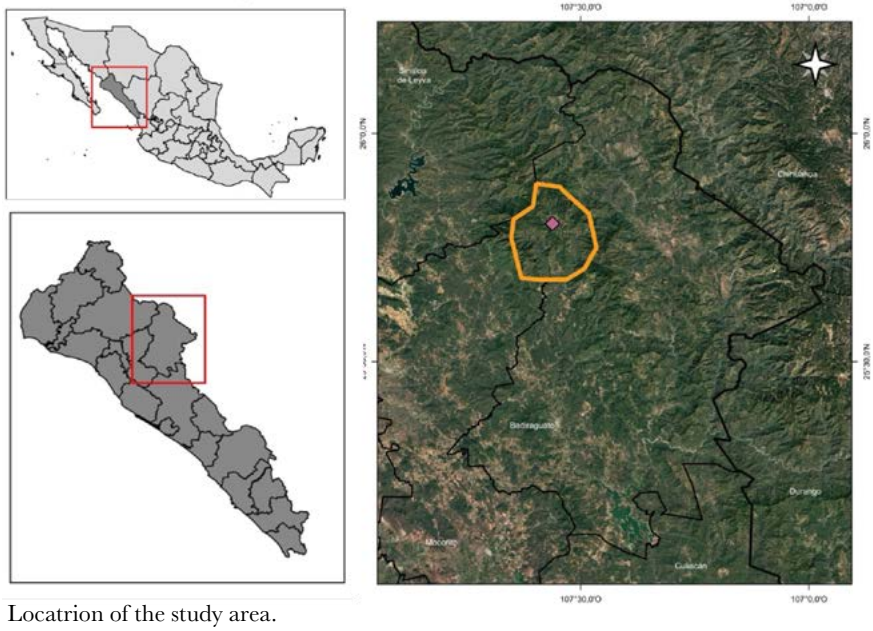

Figure 1. Locatrion of the study area.

Table 1. Dipterans identified in peach cultivation.

Order	Family	Genus	Specie	Image
Diptera	Drosophilidae	*Zaprionus*	*indianus*	
Diptera	Syrphidae	*Sphaerophoria*	sp.	
Diptera	Syrphidae	*Allograpta*	sp.	
Diptera	Syrphidae	*Allograpta*	sp.	
Diptera	Phoridae	*Phoridae*	sp.	
Diptera	Muscidae	*Muscidae*	sp.	

Source: Prepared by the authors.

They are characterized by a prominent and curved thorax (humpbacked), which gives them a distinctive appearance, short wings with reduced venation, short aristate antennae, and coloration ranging from pale tones to intense black. Their legs are robust and covered with fine setae. Females are generally slightly larger than males and tend to exhibit a lighter abdominal coloration (Disney, 1993, 1998).

Adult Muscidae are medium-sized flies, measuring between 5 and 10 mm in length. They exhibit an opaque thorax with four well-defined dorsal black longitudinal stripes, a laterally pale abdomen with checkered or spotted patterns, segmented antennae with a

plumose arista, and a subcostal vein joining the costal margin at nearly a right angle. The hind legs lack a strong seta at the base of the first tarsomere. Their general coloration is grayish to black, with variation depending on the genus (De Carvalho *et al*., 2005; Huckett & Vockeroth, 1987). *Sphaerophoria* sp. and *Allograpta* sp., both belonging to the family Syrphidae, are distinguished primarily by abdominal morphology. In *Allograpta*, the third and fourth abdominal tergites bear a central pair of yellow stripes and laterally oblique oval yellow markings, creating distinctive abdominal patterns. In contrast, *Sphaerophoria* exhibits on the third and fourth tergites a regular yellow band, occasionally divided, entirely yellow or black, but never with the oblique pattern characteristic of *Allograpta*. Additionally, in males of *Sphaerophoria*, tergite 5 is visible in dorsal view, with globose and extremely enlarged terminalia, nearly as wide as the abdomen, whereas *Allograpta* possesses five unmodified pregenital segments, thereby facilitating their separation under a stereomicroscope (Miranda *et al*., 2013). Adults of the African fig fly measure approximately 2-3 mm in length and display a generally yellowish body. They are readily distinguished by two longitudinal silvery-white lines bordered in black extending across the fronto-orbital region, mesonotum, and scutellum. They exhibit reduced prescutellar setae, a costal index close to 2.6, and subapical setae on the fourth and fifth tergites. The wings are transparent, with the typical drosophilid venation characterized by its simplicity. The antennae are short and bear a plumose arista. This invasive species is particularly notable for its unique cephalic and thoracic pattern, which facilitates its identification in the field (Yuzuki & Tidon, 2020). Of the six morphotypes identified, three families (Syrphidae, Phoridae, and Muscidae) play an important role in agroecosystems: a) adults of Syrphidae are frequently found on flowers, feeding on nectar and pollen, and may therefore act as effective pollinators, whereas their larvae feed primarily on soft-bodied hemipterans, such as aphids (Aphidoidea) and psyllids (Psylloidea), making them valuable agents of biological pest control (Lorite *et al*., 2025; McCallan, 1955; Violi *et al*., 2025); b) in the case of Phoridae, most adults feed on nectar, honeydew, sap, fresh carrion, and feces, while some also consume the bodily fluids of live beetle larvae and pupae (Grundmann *et al*., 2025); and c) Muscidae participates in the decomposition of organic matter (Magoai *et al*., 2025). Therefore, it may be inferred that peach crops harbor populations of aphids and psyllids, and that these flies are acting as biological control agents and pollinators; consequently, their conservation is essential. The African fig fly is a species native to tropical Africa (EPPO, 2020; Tidon *et al*., 2003) that, over the past three decades, has exhibited extraordinary invasive capacity throughout the American continent. Its first published record in the Americas dates to March 1999 in São Paulo, Brazil, on fallen persimmon fruits (Lavagnino *et al*., 2008; Tidon *et al*., 2003), from where it spread rapidly across South America, Central America, and North America (EPPO, 2020; Joshi *et al*., 2014). This species displays a remarkable altitudinal range. In Ecuador, it has been collected at 3,900-4,000 metres above sea level in the Guamaní Páramo and at 2,500 metres above sea level on the slopes of Ilaló Volcano, Tumbaco, and Otongachi. These elevations are notably higher than those of Surutato, Sinaloa (1,400-1,600 metres above sea level), demonstrating that the species is capable of colonizing montane environments with temperate to cold climates (Rafael, 2007).

In temperate regions of North America (Pennsylvania, Virginia, and Connecticut), the fly survives and reproduces during autumn, showing rapid evolution toward reduced wing size and a lower wing-to-thorax ratio within a single season, as well as increased cold tolerance under laboratory conditions after only a few generations (Erickson *et al.*, 2025; Gray *et al.*, 2025; Wallsten, 2025). The winter minimum temperatures of Surutato (2-5 °C) are less extreme than those of Pennsylvania or Virginia, where the species is already undergoing adaptation (Joshi *et al.*, 2014; Wallsten, 2025).

The environment of Surutato is dominated by pine, as are other regions where the African fig fly has been recorded, such as central Veracruz in 2019 (Flores-Sánchez *et al.*, 2024), Chiapas in 2002 (EPPO, 2020), and Michoacán (Cruz-Esteban, 2021), all of which include altitudinal gradients and pine-oak formations. Moreover, it has been found in peach orchards in Argentina (Gonsebatt *et al.*, 2020) and is capable of exploiting more than 80 species of cultivated and wild fruits (EPPO, 2020; Lavagnino *et al.*, 2020), many of which, including peach, fig, plum, and blackberry, are present in the Sierra of Sinaloa.

Its adaptability to different breeding substrates (Lavagnino *et al.*, 2020), together with its demonstrated capacity for rapid evolution within less than a single season in temperate environments (Gray *et al.*, 2025; Wallsten, 2025), makes its adaptation to the conditions of Surutato highly plausible. The expansion trajectory from Chiapas (2002) and Veracruz (2019) toward northwestern Mexico (EPPO, 2020; Flores-Sánchez *et al.*, 2024) places Sinaloa within the natural dispersal route of the species. It is therefore inferred that, based on its altitudinal records, cold tolerance, host availability, and environmental adaptability, the African fig fly may establish successfully in Surutato, Sinaloa. The detection of syrphids (*Sphaerophoria* sp. and *Allograpta* sp.) underscores the importance of conserving beneficial species that act as pollinators and biological control agents of pests, since most of the captured specimens feed on aphids, psyllids, and the bodily fluids of the larvae of these pest organisms. Accordingly, chemical insecticides should not be used; rather, alternative control methods that do not affect beneficial fauna should be implemented. Furthermore, because the dipterans were obtained from traps placed in peach crops, it is necessary to collect fruits still attached to the tree as well as fallen fruits containing larvae, in order to incubate them under laboratory conditions and determine whether the African fig fly behaves as a primary or secondary pest. It is also important to determine the pathways and fruits that most likely facilitated the introduction of this species, with the aim of establishing phytosanitary barriers to prevent this and other exotic species from continuing to reach the community.

CONCLUSIONS

The identification of six morphotypes of the order Diptera in Surutato, Sinaloa, reveals the diversity of dipterans and their influence on local agroecosystems. The confirmed presence of the African fig fly, an invasive species associated with damage in fruit crops documented in some regions of South America, suggests a relationship with the premature drop of peach fruits, although more in-depth analysis is required to determine whether it attacks healthy fruits or those previously damaged.

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