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Authors: Lasa, Rodrigo, and Tadeo, Eduardo

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Invasive drosophilid pests *Drosophila suzukii* and *Zaprionus indianus* (Diptera: Drosophilidae) in Veracruz, Mexico

Rodrigo Lasa and Eduardo Tadeo*

The spotted wing drosophila, *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae), and the African fig fly, *Zaprionus indianus* Gupta (Diptera: Drosophilidae), are invasive pests of soft fruit and berries that have recently been introduced to the Americas. *Drosophila suzukii* is native to Southeast Asia (Walsh et al. 2011). It was collected for the first time in North America in California in 2008 and rapidly spread to Utah, Louisiana, North Carolina, South Carolina, Wisconsin, Michigan, Florida, Virginia, Montana, Wisconsin, Pennsylvania, and New Jersey, and reached parts of Canada in 2010 (Hauser 2011; Lee et al. 2011). The pest was recorded for the first time in Mexico in 2011 in Los Reyes, Michoacán State, and rapidly expanded to the states Colima, Guanajuato, Aguascalientes, State of Mexico, and Baja California (SENASICA 2013). *Drosophila suzukii* is considered a primary pest, and the host range includes a number of soft- and thin-skinned fruit such as cherry, *Prunus* spp. (Rosales: Rosaceae), and blueberry, *Vaccinium corymbosum* L. (Ericales: Ericaceae) (Walsh et al. 2011). Recently, high capture levels of *D. suzukii* were observed in traps hung on guava (*Psidium guajava* L.; Myrtales: Myrtaceae) trees in Baja California (De los Santos Ramos et al. 2014). Guava is not included as a host in Mexico (SENASICA 2013), and detailed studies are still needed to determine if *D. susuzkii* is a primary or secondary pest on this crop.

The African fig fly, *Z. indianus*, is native to sub-Saharan Africa (van der Linde et al. 2006). This pest was first recorded in the New World in São Paulo, Brazil, in 1999 (Vilela 1999), and rapidly expanded along the Atlantic coast of South America. This fly was detected for the first time on the North American continent in Chiapas, Mexico, in 2002 (Castrezana 2007), and Florida in 2005 (van der Linde et al. 2006). The current distribution of this pest in North America is uncertain but it has been recorded from the US states South Carolina, Georgia, Florida, Alabama, Mississippi, Texas, Oklahoma, Arizona, California, and Virginia (van der Linde 2010; Joshi et al. 2014), and Southern Ontario and Québec in Canada (Renkena et al. 2013). This pest has received little attention in Mexico, but has been reported from the states Sonora, Guanajuato, Querétaro, and Oaxaca (Castrezana 2007; Markow et al. 2014). The fly is mainly considered a secondary pest, infesting damaged fruits of more than 70 species from over 30 families, including guava (van der Linde et al. 2006). This pest has been considered a primary pest only in the fig *Ficus carica* L. var. Roxo de Valinhos (Rosales: Moraceae), but a secondary pest in other fig cultivars (Vilela & Goñi 2015). Steck (2005) also indicated its presence in ripe fruits taken directly from the tree of *Malpighia emarginata* [Moc. & Sesse] ex. DC. (Barbados cherry, acerola; Malpighiales: Malpighiaceae) and *Dimocarpus longan* Lour. (longan; Sapindales: Sapindaceae) in Florida, and noted that only a small percentage of them may have been damaged.

In a recent study performed between 26 Aug and 23 Sep 2014, both species were detected in experimental bottle traps (polyethylene) that were being used to evaluate the efficacy of 2 hydrolyzed proteins as lures for monitoring *Anastrepha* species (Diptera: Tephritidae) populations in guava. This trap has been described elsewhere (Lasa et al. 2014). The experiment consisted of 10 bottle traps baited with either the chemically hydrolyzed protein Captor 300 + borax (Promotora Agropecuaria Universal, Mexico City, Mexico) or the enzymatically hydrolyzed protein CeraTrap® (Bioibérica, Barcelona, Spain) and placed at a height of 3 m on the branches of guava trees in an orchard located at 1,183 m attitude in Xico, Veracruz, Mexico (19°25'8.21"N, 96°58'30.74"W). Traps were emptied, sorted, and rotated during 4 consecutive weeks to avoid a position effect.

In total, 471 drosophilid flies were observed in all traps; 55.0% (259) of these were *D. suzukii* and 26.3% (124) were *Z. indianus* (Table 1). CeraTrap®-baited traps captured significantly more *D. suzukii* and *Z. indianus* than Captor + borax–baited traps (Table 1). CeraTrap® also tended to capture a greater number of other drosophilids (Table 1). No significant differences were observed between lures in the mean percentage of females captured per trap for *D. suzukii* ($t = 0.238$; df = 8; $P = 0.818$) and other drosophilids ($t = 1.99$; df = 8; $P = 0.081$), but Captor + borax captured a higher percentage of Z*. indianus* females than CeraTrap® ($t = 2.417$; df = 8; $P = 0.042$) (Table 1). Hydrolyzed proteins are not commonly used to monitor drosophilids, but CeraTrap® was

Table 1. Mean (± SE) number of flies per trap per day of *Drosophila suzukii*, *Zaprionus indianus*, and other drosophilids captured in traps baited with CeraTrap® and Captor + borax in a guava orchard in Xico, Veracruz, Mexico.

	CeraTrap®		Captor + borax		Flies/trap/day comparison		
Species	Flies/trap/day	Percentage female	Flies/trap/day	Percentage female	*t*	df	*P*
D. suzukii	1.47 ± 0.38*	79.6 ± 6.2	0.38 ± 0.11	94.3 ± 3.9	2.743	8	0.041
Z. indianus	0.59 ± 0.04*	56.7 ± 5.0	0.29 ± 0.12	76.0 ± 6.2	2.125	8	0.042
Other drosophilids	0.46 ± 0.11	74.4 ± 5.0	0.17 ± 0.08	69.8 ± 18.4	2.107	8	0.068

*Indicates significant difference in flies per trap per day within a row.

Instituto de Ecología AC, Red de Manejo Biorracional de Plagas y Vectores, 91070 Xalapa, Veracruz, Mexico
*Corresponding author; E-mail: rodrilasa@gmail.com

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reported as an effective lure for monitoring *D. suzukii* when compared with apple cider vinegar in Spain (Escudero et al. 2011).

This scientific note represents the first records of these invasive species in Veracruz, a state in which large areas are dedicated to the production of *Citrus* species (Sapindales: Rutaceae); mango, *Mangifera indica* L. (Sapindales: Anacardiaceae); pineapple, *Ananas comosus* (L.) Merr. (Poales: Bromeliaceae); tomato, *Solanum lycopersicum* L. (Solanales: Solanaceae); watermelon, *Citrullus lanatus* (Thunb.) Matsumara & Nakai (Cucurbitales: Cucurbitaceae); and papaya, *Carica papaya* L. (Capparales: Caricaceae). The region of Xico, Veracruz, Mexico, is characterized by a humid climate (average annual temperature 19–20 °C), warm winters, and rainfall throughout the year. These conditions favor the reproduction of *D. suzukii* populations (Hauser et al. 2009; Walsh et al. 2011). Calabria et al. (2010) suggested that *D. suzukii* appears to prefer higher altitudes with less extreme summer temperatures and high humidity, which differs from the warmer Mediterranean-type climate in which this pest was discovered initially in the United States and Europe. In contrast, *Z. indianus* usually prefers a warm climate although adaptation to cooler climates has been documented previously (da Mata et al. 2010), indicating plasticity in tolerance to environmental conditions and an ability to survive in temperate regions.

The rapid and widespread invasion by both pests in North America is an indication of their great colonizing ability. The prevalence of both invasive pest species in guava orchards, with more than 80% of captured drosophilid flies comprising these exotic species, highlights the importance of defining the ecological niche of these pests in Mexico and their possible interaction with pestiferous tephritids (*Anastrepha* spp.) that commonly infest guava. Studies on the impact of both pests in commercial guava, their current geographical distribution, and infestation of other commercial and natural fruit species in this region should be considered a priority.

We thank the Centro Nacional de Referencia (SENASICA) for confirmation of the identification of exotic drosophilid species.

Summary

The invasive drosophilid pests *Drosophila suzukii* (Matsumura) and *Zaprionus indianus* Gupta (Diptera: Drosophilidae) were captured in traps baited with hydrolyzed protein lures during a trial aimed at monitoring *Anastrepha* flies infesting guava, *Psidium guajava* L. (Myrtales: Myrtaceae) in Xico, Veracruz, Mexico, during Sep 2014. This is the first record of these species in Veracruz State. These exotic species represented over 80% of the total drosophilid flies captured. Studies on the commercial impact of these pests in guava and in the production of other fruit species in the region should be considered a priority.

Key Words: invasive pest; CeraTrap; *Psidium guajava*

Sumario

Las especies invasoras *Drosophila suzukii* (Matsumura) and *Zaprionus indianus* Gupta (Diptera: Drosophilidae) fueron capturadas en trampas utilizadas para el moniotoreo de moscas del genero *Anastrepha* en árboles de guayaba, *Psidium guajava* L. (Myrtales: Myrtaceae) en Xico, Veracruz, México, durante el mes de septiembre 2014. Más del 80% de las drosophilas capturadas en las trampas correspondieron a las especies invasoras. Se considera una prioridad realizar estudios sobre el impacto comercial de estas plagas en guayaba y en la producción de otras especies de frutos de la región.

Palabras Clave: plaga invasiva; CeraTrap; *Psidium guajava*

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