N O T E

First Detections of *Zaprionus indianus* (Diptera: Drosophilidae) in Minnesota[1]

Sarah G. Holle[2], Anh K. Tran, Eric C. Burkness, Dominique N. Ebbenga, and W.D. Hutchison

Department of Entomology, University of Minnesota, 1980 Folwell Avenue, Saint Paul, MN 55108 USA

J. Entomol. Sci. 54(1): 99–102 (January 2019)

Key Words invasive species, African fig fly, early detection

Zaprionus indianus Gupta (Diptera: Drosophilidae), also known as the African fig fly, is native to the tropical regions of Africa (Renkema et al. 2013, J. Entomol. Soc. Ont. 144: 125–130). *Zaprionus indianus* can be identified by the even number of conspicuous silvery stripes outlined in black on the dorsal side of the head and thorax (Renkema et al. 2013; van der Linde et al. 2006, Florida Entomol. 89: 402–404). Specimen coloration on the head and thorax can range from yellow (van der Linde et al. 2006) to a darker reddish-brown (Renkema et al. 2013), with the anterior femora having 4–6 distinct composite spines, each with a second short branch (van der Linde et al. 2006). *Zaprionus indianus* spread to South America in 1998, with the first detection in Brazil (David et al. 2006, Heredity 96: 53–62). In North America, *Z. indianus* was first detected in Florida in 2005 (van der Linde et al. 2006). As of 2012, detections of *Z. indianus* in the United States were confirmed as far west as California and as far north as Wisconsin, Michigan, Connecticut, and New York, with a total of 14 states reporting detections between 2006 and 2012 (van der Linde, 2012, http://www.kimvdlinde.com/professional/Zaprionus%20distribution%20US.php). In Canada, *Z. indianus* was confirmed in Ontario and Quebec in 2013 (Renkema et al. 2013). As analyzed by Lichtenberg and Olson (2018, PLoS One 13(2): e0192280), the recent expansion of international trade has greatly increased the risk of introducing nonnative pest species and contributing to deleterious ecological and agricultural impacts, particularly for fruit and vegetable crops. The high volume of international trade, thus, provides one plausible explanation as to how *Z. indianus* entered North America.

[1]Received 27 February 2018; accepted for publication 11 June 2018.

[2]Corresponding author (email: holle248@umn.edu), University of Minnesota, 1980 Folwell Avenue, St. Paul, MN 55108 USA.

Despite its common name, *Z. indianus* will colonize and oviposit on damaged or decaying fruit of a variety of plant species (van der Linde et al. 2006). In its native range of Africa, 74 species of fruit are known to be suitable hosts; additionally, 17 more species have tested positive as hosts in Florida such as pond apple, *Annona glabra* L., and grapefruit, *Citrus* × *paradisi* Macfadyen (van der Linde et al. 2006). In Brazil, *Z. indianus* rapidly became a pest of fig fruit, *Ficus carica* L. In a study by Gomes et al. (2002, Braz. J. Microbiol. 34: 5–7), the yeast, *Candida tropicalis* (Castellani) Berkhout, was found in all figs damaged by *Z. indianus*, suggesting that this insect is a carrier of the yeast, which can contribute to fruit decomposition. Although *Z. indianus* is a generalist, its interaction with fig is unique in that females will oviposit eggs near the ostiole prior to maturation of the fruit, which also infects the fruit with *C. tropicalis* (Matevelli et al. 2015, J. Insect Physiol. 82: 66–74). This behavior may have contributed to its pest status. Within the first year of detection in Brazil (1998), exports of figs from São Paulo were reduced by 50%, resulting in estimated annual losses of $767,000 USD due to *Z. indianus* damage (Oliviera et al. 2013, J. Appl. Entomol. 137: 1–15). Interestingly, *C. tropicalis* is also known to be a human pathogen that is implicated as one of the more important *Candida* species for epidemiology and virulence (Zuza-Alves et al. 2017, Front. Microbiol. 8: 1927)

In this report, we provide confirmation of the first detections of *Z. indianus* adults in Minnesota via a trapping network for the invasive, drosophila, *Drosophila suzukii* (Matsumura). From 2013 to 2016, apple-cider vinegar traps were deployed to monitor *D. suzukii* populations (Asplen et al. 2015, J. Pest Sci. 88: 469–494). Traps were placed at various farms surrounding the Minneapolis–St. Paul metropolitan area and in southeast Minnesota, including a vineyard located 8.1 km south of Hastings, MN and the Rosemount Research and Outreach Center near Rosemount, MN, which is 23.5 km west of the vineyard. Traps were checked weekly, from late May to September. In 2017, commercially available Scentry® traps (Great Lakes IPM, Vestaburg, MI) developed for *D. suzukii* and baited with a four-component lure (Cha et al. 2017, Environ. Entomol. 46: 907–915) were used for monitoring *D. suzukii*. Scentry traps contain a lure that consists of a blend of acetic acid, ethanol, acetoin, and methionol (Cha et al. 2017) and 100 ml of water in the bottom of the trap mixed with a drop of dish soap to break the surface tension. One advantage of the Scentry traps (with water) and the four-component lure is that it minimizes the number of nontarget insects collected (Cha et al. 2017), especially compared to apple-cider vinegar or other fermenting bait traps designed for *D. suzukii* (Asplen et al. 2015). Scentry traps were deployed at the Rosemount Research and Outreach Center near Rosemount, MN, and the vineyard near Hastings, MN, in addition to locations that were part of the ongoing trapping network throughout the Minneapolis–St. Paul metropolitan area with data posted to the FruitEdge™ website (https://www.fruitedge.umn.edu/swdtrap). Traps at the vineyard were removed in mid-September following the completion of grape harvest. However, three traps for *D. suzukii* were monitored until mid-December at the Rosemount Research and Outreach Center.

The first detection of *Z. indianus* in Minnesota occurred in September 2013, at the vineyard near Hastings, MN (N 44.685345; W −92.871799), where one female fly was found in an apple cider vinegar trap in wine grapes (e.g., Frotenac, *Vitis vinifera* × *riparia* (data not shown) (African Fig Fly, 2014, FruitEdge. https://www.fruitedge.umn.edu/affalert); this specimen was confirmed by Allen L. Norrbom of the

Table 1. Mean weekly trap catch (±SEM) of *Z. indianus* in Scentry-baited traps (for *D. suzukii*) at tree line adjacent to a fall raspberry field near Rosemount, MN, 2017.

Sample Date*	Total Counts	Mean ± SEM/Trap
13 October	4	1.33 ± 2.31
19 October	95	31.67 ± 8.50
26 October	17	5.67 ± 4.62
2 November	1	0.33 ± 0.58

* Traps examined for *Z. indianus* on sample dates from 22 June to 6 October and 9 November to 5 December 2017 did not result in positive detections.

Systematic Entomology Laboratory, Agricultural Research Service, USDA (Washington, DC). No subsequent detections of *Z. indianus* were observed in Minnesota until October 2017, when several adult flies were found in Scentry traps near Rosemount, MN (Table 1). Specimens of *Z. indianus* were placed in the Insect Museum, Department of Entomology, University of Minnesota. *Zaprionus indianus* were found in traps collected from 13 October until 2 November 2017, with a peak mean catch of 31.67 ± 8.5 adults per trap per week on 19 October. Traps positive for *Z. indianus* were located on the edge of a tree line, within 10 m of an adjacent raspberry planting used for research purposes (N 44.728363; W −93.097024). Despite the reduction of nontarget flies caught in the Scentry trap with the improved four-component lure (Cha et al. 2017), the substantial numbers of *Z. indianus* trapped in 2017 indicates that this trap/lure could serve as a potential monitoring tool for *Z. indianus* as well as for *D. suzukii*.

In Minnesota, *D. suzukii* has been an opportunistic and economic pest of all small berry crops since 2012 (Asplen et al. 2015). The possible addition of *Z. indianus* as an additional species within the pest complex could be problematic. Bernardi et al. (2017, Neotrop. Entomol. 46: 1–7) demonstrated that in strawberry, *Fragaria* × *ananassa* Duch., prior feeding damage by *D. suzukii* can create a habitat that is significantly more suitable for *Z. indianus* oviposition and adult development. The coexistence of *D. suzukii* with *Z. indianus*, which causes primary damage in ripening fruit and accelerates decay and secondary damage, could lead to potential increases in damage for Minnesota fruit crops. The detections of *Z. indianus* in temperate northern states suggests either long-distance migration could be involved, given the potential for long-distance movement observed with many other fruit fly species (Asplen et al. 2015; Chapman et al. 2005, Bull. Entomol. Res. 94: 123–136), or the capacity to adapt to conditions outside of its original tropical environment, which has also been observed in other fruit fly species (da Mata et al. 2008, Biol. Invasions 12: 1231–1241).

After spreading to the northern United States, *Z. indianus* was documented in Ontario and Quebec, Canada, in apple cider vinegar traps used for surveying *D. suzukii*. The *Z. indianus* specimens were collected from peach (*Prunus persica* L.), blueberry (*Vaccinium* spp. L.), raspberry (*Rubus idaeus* L.), strawberry (*Fragaria* × *ananassa* (Weston) Duchesne ex Rozier (pro sp.)), cherry (*Prunus* spp. L.), and plums (*Prunus* spp. L.) during pre- and postharvest (Renkema et al. 2013). Many of these crops are specialty crops also grown in Minnesota and face pest pressure from *D. suzukii*. The generalist behavior in crop choice by *Z. indianus* (Renkema et al. 2013), in addition to physiological elasticity in a variety of climates, provides a basis for a niche shift in this species (de Mata et al. 2008) and, thus, the potential for *Z. indianus* to colonize Minnesota fruit crops. However, in 2013 and 2017, despite early season monitoring, *Z. indianus* was not found until September and October, respectively, which suggests that early season crops may not be at risk for damage by *Z. indianus*. Additional research, including more extensive monitoring studies, will be required to determine if *Z. indianus* consistently occurs in Minnesota and, if so, how the season long phenology of *Z. indianus* will overlap with crop phenology. Moreover, additional information on the biology, phenology, and host preferences of *Z. indianus* and *D. suzukii* will be needed to better understand what crops may be most at risk in Minnesota and the upper Midwest region.

Acknowledgments. The authors appreciate the expertise of Allen L. Norrbom of the Systematic Entomology Laboratory, Agricultural Research Service, USDA for identifying specimens and Robert Koch, University of Minnesota, for reviewing a previous draft of the manuscript. This research was supported in part by the Rapid Agricultural Response Fund of the Minnesota Agricultural Experiment Station, St. Paul Campus, University of Minnesota (UMN), and the UMN Extension Integrated Pest Management Program (NIFA Project no. 2017-70006-27278).