N O T E

Monitoring of *Drosophila suzukii* (Diptera: Drosophilidae) in Three Berry Crops Grown in Tunnels[1]

Salvador Ordaz-Silva, Luis Fernando Gómez-Pérez, Imelda Virginia López-Sánchez, Jorge Luis Delgadillo-Ángeles, Julio César Chacón-Hernández[2,3], and José Guadalupe Pedro-Méndez

Facultad de Ingeniería y Negocios San Quintín, Universidad Autónoma de Baja California, Carretera Ensenada-San Quintín, Km 180.2, Ejido Padre Kino, San Quintín, Baja California, 22930 México.

J. Entomol. Sci. 54(2): 83–86 (April 2019)

Key Words Spotted wing drosophila, monitoring, berry production

Global berry production was greater than 11 million tons in 2013, with Mexico being the fifth largest berry producer in the world, following China, United States, Russia, and Poland. In 2003, Mexico's production value represented 3.1% of the total agricultural production value (FIRA, 2016, Panorama Agroalimentario. Berries. Dirección de Investigación y Evaluación Económica Sectorial). Blackberry, *Rubus ulmifolius* Schott, blueberry, *Vaccinium myrtillus* L., and strawberry, *Fragaria* × *ananassa* Duch (Rosaceae), are considered medicinal plants with anticold, antiseptic, diuretic, anti-inflammatory, antioxidant, astringent, and antispasmodic effects (Neves et al. 2009, J. Ethnopharmacol. 124: 270–283; Helmstädter and Schuster 2010, Pharmazie. 65:315–321; Martins et al. 2014, Food Funct. 1091–1100; Abdulazeez and Ponnusamy 2016, Pak. J. Pharm. Sci. 29: 255–260; Pinela et al. 2017, Food Chem. Toxicol. 165–188).

Berry crops are hosts to a great diversity of insect pests. In recent years, the most important pest of grapes and stone fruits has been the spotted wing drosophila, *Drosophila suzukii* Matsumura (Diptera: Drosophilidae) (Zerulla et al. 2017, PLoS One. 12: e0187682) and has been reported to cause economic crop losses in its native Asia, as well as in Europe and in the American continent (Asplen et al. 2015 J. Pest. Sci. 88: 469–494). This pest has been reported in Mexico from Aguascalientes, Baja California, Colima, Guanajuato, Jalisco, Michoacan, Estado de Mexico, and Veracruz. *Drosophila suzukii* larvae damage fruit by feeding on the pulp while inside the fruit. Infested fruits show visible staining until dropping around

[1]Received 8 July 2018; accepted for publication 27 July 2018.
[2]Corresponding author (email: jchacon@uat.edu.mx).
[3]Instituto de Ecología Aplicada, Universidad Autónoma de Tamaulipas, División del Golfo 356, Colonia Libertad, Cd. Victoria, Tamaulipas, 87019, México.

the plants. The egg-laying scar exposes fruits to secondary attacks of pathogens and other insects, leading to rotting (CABI 2018, https://www.cabi.org/isc/datasheet/109283, accessed 28 June 2018).

Drosophila suzukii requires monitoring throughout the year (Escudero 2016, Rev. Agron. Noroeste Argent. 36: 19–31), and trapping with some type of attractants is routinely and successfully used in integrated pest management programs. Therefore, the purpose of this study was to assess the effectiveness of apple vinegar and yeast as attractants in capturing and monitoring *D. suzukii* in three berry crops.

The study was conducted at Driscoll's test plot located in "Valle de San Quintín", Baja California, Mexico. Traps consisted of 1-L clear plastic flasks with holes drilled in the middle. Flasks were closed with plastic lids after introducing the attractants, namely, either yeast or apple vinegar. The test crops were strawberry, blackberry, and blueberry, with the latter in two cultural media (soil and substrate). All were planted under plastic tunnels at 36 $\pm$ 4°C and 80% $\pm$ 10% relative humidity (RH). Two traps per attractant were placed in each crop and were separated by 30 m. We sampled for *D. suzukii* during 3 weeks (8, 13, 17, and 24 February 2018). Attractant solutions were changed in the traps each week. We confirmed the presence of *D. suzukii* adults (egg-laying apparatus in females and wings in males) by using the key by Légaré et al. (2013, https://www.agrireseau.net/lab/documents/Drosophila_suzukii_2013_V7.pdf, accessed 28 June 2018). Data were analyzed using the three-way analysis of variance and Fisher's least significant difference means comparison. A Student's *t*-test determined differences between spotted-wing drosophila males and females (SAS 2002, SAS Institute, Cary, NC).

The two attractants had similar effects on *D. suzukii* (males and females) ($F = 4.38$; df = 22, 1; $P = 0.0659$). Their numbers differed significantly among the berry crops ($F = 23.69$; df = 22, 3; $P = 0.0001$), the weeks of monitoring (8, 13, and 17 February 2018) ($F = 9.12$; df = 22, 3; $P = 0.0043$) (Fig. 1), as well the interaction between the weeks of monitoring and the crop ($F = 5.35$; df = 22, 9; $P = 0.01$) (Fig. 2). In contrast, there were no differences in the interaction among attractants*crop, attractants* weeks of monitoring ($F = 4.38$; df = 22, 1; $P = 0.0659$; $F = 1.16$; df = 22, 3; $P = 0.3759$; and $F = 3.22$; df = 22, 3; $P = 0.0757$; respectively). Spotted wing drosophila were not observed on the two baits in the blackberry crop, perhaps because of a repellant effect. The traps did not have flies in any of the monitoring dates, so we are looking for new alternatives to monitor this pest in blackberry crops.

Because there were no differences between attractants and *D. suzukii* attracted to both baits, these substances can prove useful in the monitoring program designed to manage spotted wing drosophila (Burrack et al. 2018, Environ. Entomol. 44:704–712). The yeast bait was slightly more efficient than the apple vinegar bait (Fig. 1). However, the apple vinegar bait is usually clear and, therefore, it is easier to rinse the samples, enabling quick identification in the field and in the laboratory. Furthermore, apple vinegar acts as a preservative of the trapped specimens, whereas the yeast bait is turbid and forms sediments that make identification more difficult. In fact, the preference of one type of bait over another is a personal decision (Iglesias et al. 2014, J. Econ. Entomol. 107:1508–1518).

During the third week, we observed larger numbers of *D. suzukii* in strawberry, followed by the blueberry grown in soil. Overall, the numbers of the pest increased in the third week (Fig. 2) probably because the crops reached the fruit preripening

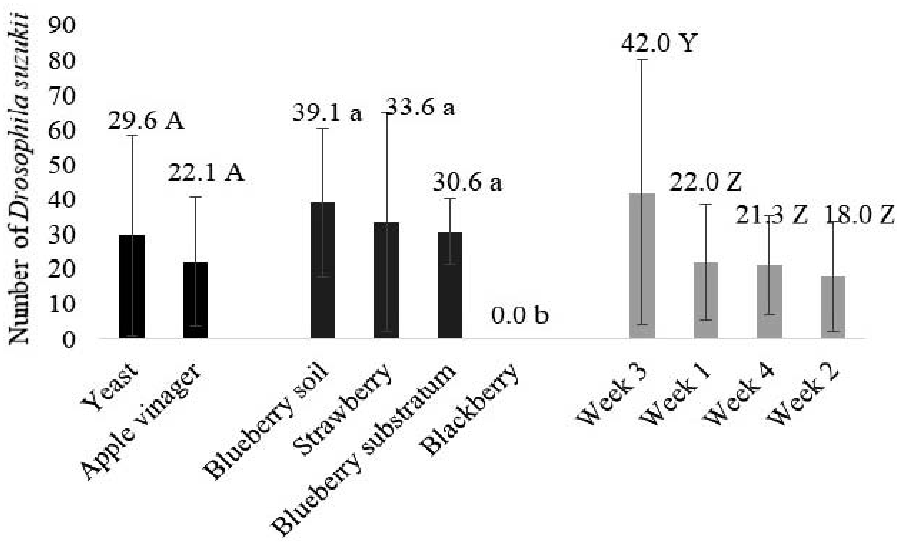

Fig. 1. Mean ± standard deviation (SD) of *D. suzukii* captured in traps by using two attractants in different berry crops on different collection weeks.

stage. At this stage, fruit is most vulnerable to the attack of this pest because the insect lays the eggs under the skin of mature and ripening fruits where the larvae will feed on the pulp, causing the loss of fruit turgor and marketability (Rota-Stabelli et al. 2013, Curr. Biol. 23: 8–9).

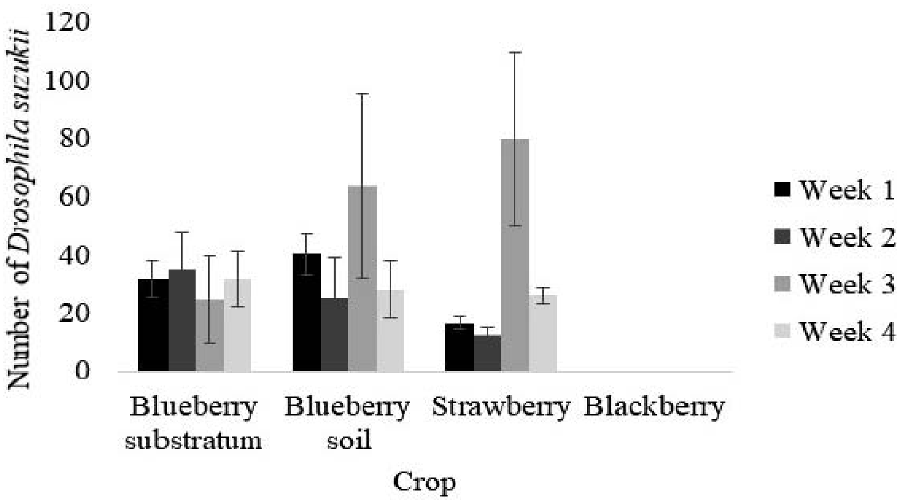

Fig. 2. Mean ± SD of *D. suzukii* on the different crops and different collection weeks.

Insecticide applications can supplement mass capture of *D. suzukii* which, in turn, can help reduce insecticide use. Furthermore, the traps with different attractants can form part of an integrated pest management program that must be adapted to each berry crop because affected crops require different actions. Such programs may depend on the available and efficacious insecticides and/or crop market value (Escudero 2016).

The number of females captured was significantly greater than the number of males over the study period ($t = 2.69$; df $= 62$; $P = 0.0099$) (Female: $\bar{x} = 17.21$; Male: $\bar{x} = 8.26$). During the first week of monitoring, we found 16, 40, and 31 *D. suzukii* in strawberry, blueberry grown in soil, and blueberry grown in substrate, respectively. These results show the efficiency of apple vinegar and yeast in the monitoring of spotted wing drosophila. One spotted wing drosophila female can lay up to 500 eggs and, under optimal environmental conditions, the complete life cycle takes 9–11 d (Zerulla et al. 2017). We, therefore, recommend using some type of control (chemical or biological) when finding a spotted wing drosophila in a trap.