The Canadian Entomologist (2020), **152**, 411–414
doi:10.4039/tce.2020.40

Published on behalf of the Entomological Society of Canada

SPECIAL ISSUE INTRODUCTION

The spotted-wing drosophila, *Drosophila suzukii* (Diptera: Drosophilidae)

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(Received 7 May 2020; accepted 7 May 2020)

In late summer 2008, a fruit fly (Diptera: Drosophilidae) from a berry field in Santa Cruz County, California, United States of America, was identified as *Drosophila* Fallén species (Bolda *et al.* 2010; Hauser *et al.* 2009; Hauser 2011). Fruit flies were not unusual in late summer fruit fields, and it was thought this was a common species that infested rotting fruit. It was not, but its significance was not appreciated at the time. In 2009, heavy infestations of maggots in otherwise healthy cherries (*Prunus* Linnaeus; Rosaceae) in California were identified as the invasive species, *Drosophila suzukii* (Matsumura), the spotted-wing drosophila (Hauser 2011). This was the first detection of *D. suzukii* in continental North America. It was originally described from Japan (Kanzawa 1939), and its native habitat is Asia (Centre for Agriculture and Bioscience International 2020), including India, the Korean Peninsula, and Thailand (Hauser *et al.* 2009).

Since 2008, *D. suzukii* has emerged as a serious pest in both Europe and North America, where it is now widespread and abundant (Walsh *et al.* 2011; Cini *et al.* 2012). In North America, it spread rapidly, presumably via human-assisted transport of fresh fruits, and is established throughout most fruit producing areas. It was first detected in Canada in 2009 in British Columbia, specifically in cherries in the Okanagan Valley, and in berries and grapes in the Fraser Valley. It reached Alberta, Manitoba, Ontario, and Québec in 2010 (Canadian Food Inspection Agency 2011), Nova Scotia in 2011 (Moreau and Foster 2012), Prince Edward Island and New Brunswick in 2012 (D.L.M., unpublished data), insular Newfoundland in 2013 (P.L.D. and D.L.M., unpublished data), and Saskatchewan in 2019 (Tansey 2019). In the United States of America, after the initial detection in California, *D. suzukii* was found in Florida in 2009 (Walsh *et al.* 2011), and by 2011, it had reached Maine (Drummond *et al.* 2018).

Why does a tiny fruit fly warrant its own special issue of The Canadian Entomologist? *Drosophila suzukii* is a highly successful invasive insect with a potential global impact on soft fruit crops. Its rapid rate of spread around the world is a cause for concern (Asplen *et al.* 2015). Apart from its dispersal abilities, it is highly polyphagous, infesting a number of wild and cultivated species of soft-skinned fruits and berries (Bolda *et al.* 2010; Centre for Agriculture and Bioscience International 2020), in both its native region and in newly invaded areas. Unlike most drosophilid fruit flies, females have a strongly sclerotised, serrated ovipositor that enables them to oviposit in healthy ripe and ripening fruit before harvest (Walsh *et al.* 2011). Larvae often are present in fruit after harvest and at market. An individual fruit can contain several larvae, which feed on the inside and cause fruit softening and collapse, and allow entry of disease causing organisms. The species is sexually dimorphic, with a large dark spot near the tip of each wing in males

but not females, giving them their common name. Several generations can occur in a season. Pupation occurs either in the fruit or on the soil, and adults are in the overwintering stage.

The sudden appearance of *D. suzukii*, along with associated novel damage, rapid spread and loss of fruit, has prompted much research and many publications. This special issue of The Canadian Entomologist includes a total of 11 papers on *D. suzukii*, nine from research groups in Canada, one from New Jersey, United States of America, and one from Veracruz, Mexico. They address a number of research areas including host range and selection, spatial distribution, overwintering, diet and nutrition, aspects of the microbiome, and integrated pest management.

Acheampong *et al.* (2020) describe the presence of and damage by *D. suzukii* in table and wine grapes (*Vitis vinifera* Linnaeus; Vitaceae) in the Okanagan Valley of British Columbia, where the insect was first detected in Canada. They studied *D. suzukii* populations in this area and report on the relative susceptibilities of damaged or intact table grapes and wine grapes. Champagne-Cauchon *et al.* (2020) studied the abundance, phenology, overwintering, and spatial distribution of *D. suzukii* in lowbush blueberry (*Vaccinium angustifolium* Aiton; Ericaceae) in Québec, relative to field proximity to forested borders. Chamberlain *et al.* (2020) report on the distribution of juvenile stages of *D. suzukii* within the fruit and tree canopy in sweet cherry (*Prunus avium* Linnaeus; Rosaceae) orchards in the Okanagan Valley in British Columbia. They present the first result concerning oviposition and survival to emergence of *D. suzukii* in a spatial context within the canopy of a sweet cherry orchard. Urbaneja-Bernat *et al.* (2020) studied the impact of noncrop habitat, primarily in wild lowbush blueberry, on the seasonal abundance/activity of adult *D. suzukii* and fruit infestation by larvae in nearby highbush blueberry (*Vaccinium corymbosum* Linnaeus; Ericaceae) fields.

Young and Long (2020), in an attempt to answer the question of why *D. suzukii* is so successful in complex and foreign environments, examined the impact of different qualities of nutritional developmental history of the juveniles on the fitness and reproductive success of the adults. Jiménez-Padilla *et al.* (2020a) determined that diet changes the fungal and bacterial components of the gut microbiota and that these changes persist through more than one generation. This is important as *D. suzukii* has such a wide host range that different individuals have different diets. Jiménez-Padilla *et al.* (2020b) show that development rate, final body size, and cold susceptibility of the immature stages depend on the species of fruit in which the insects were reared. Efforts were also made to determine temperature treatments that could be used to kill immature *D. suzukii* in packaging or in fruit.

Little *et al.* (2020) assessed the role of various fruit characteristics (firmness, sweetness, acidity) and colour on host selection and suitability by *D. suzukii* and how these might be utilised in integrated pest management. They report that several berry species important culturally or commercially in boreal regions of Canada are susceptible to infestation by this insect. Lanouette *et al.* (2020) evaluated various factors that might affect the success of the sterile insect technique, including the mating capacity and competitiveness of irradiated males, and the re-mating propensity of females. This information is essential for the eventual development of sterile insect technique to manage *D. suzukii*. In a field study, Renkema *et al.* (2020) studied the effects of interplanting peppermint (*Mentha* × *piperita* Linnaeus; Lamiaceae) to reduce *D. suzukii* infestation and damage in strawberry (*Fragaria* × *ananassa* Duchesne; Rosaceae).

We finish this series with a look at the potential future global distribution of *D. suzukii* (Reyes and Lira-Noriega 2020). Using an ecological niche modelling approach, these authors evaluated the potential worldwide distribution of *D. suzukii* under current and future climate conditions. They identified areas at high risk of infestation due to range expansion under certain scenarios of climate change.

Since the detection of *D. suzukii* in Canada 11 years ago, there has been a great deal of research activity, some of which is reflected in this special issue of The Canadian Entomologist. However, as always with a new invasive pest, particularly one with the destructive potential of *D. suzukii*, there is need for more. We hope that this compilation will be a useful contribution to scientists and

https://doi.org/10.4039/tce.2020.40 Published online by Cambridge University Press

extension personnel working with this challenging insect and help identify fruitful avenues of future research.

Acknowledgements.. The guest editors sincerely thank all participating authors, and also Kevin Floate, past Editor-in-Chief of The Canadian Entomologist, for the initial invitation to create this special issue on the spotted-wing drosophila.

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Cite this article: Dixon, P.L. and Moreau, D.L. 2020. The spotted-wing drosophila, *Drosophila suzukii* (Diptera: Drosophilidae). The Canadian Entomologist, **152:** 411–414. https://doi.org/10.4039/tce.2020.40.