

## Spotted wing drosophila, *Drosophila suzukii* (Matsumura)

### Introduction

The spotted wing *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae) is a frugivorous fruit fly native to East Asia. It has first been recorded as invasive in Hawaii in 1980 and has then successfully spread in other parts of Asia as well as in the Americas, Europe, and Africa. This species has a high reproductive rate and a short generation time, allowing it to have >10 generations per year in some regions of the world. The fly is highly polyphagous, developing in a wide range of economically important crops, such as blackberries, blueberries, cherries, raspberries, and strawberries; but also in fruits of >100 non-crop and wild host plants. In contrast to most other Drosophilidae, *D. suzukii* females have a serrated egg-laying apparatus (ovipositor), enabling them to pierce through the skin of undamaged ripening and ripe fruits. Primary damage to the attacked fruits occurs through the oviposition hole itself but mainly by larval feeding inside the fruit, and secondary damage is caused by the entry of bacteria and fungi through the oviposition holes. High population levels of *D. suzukii* can cause substantial damage in soft-skinned fruit crops, that lead to significant economic losses. Preventive and protective measures, such as frequent harvest intervals and exclusion of the fly by nets, are time and cost-intensive. Control measures in crops, such as application of insecticides or augmentative biological control, have only short-term local effects because of frequent re-infestations from the populations in non-crop fruits. Thus, classical biological control is a promising option for reducing *D. suzukii* damage below an economical threshold.

### History of classical biological control against *D. suzukii*

Foreign explorations for natural enemies of *D. suzukii* in China, South Korea, and Japan during 2013-2017 showed that in its native range, parasitoids play an important role in population regulation. Independent research groups from Switzerland, France, Italy, and the USA discovered a rich diversity of 14 parasitoid species, from which three dominant larval parasitoids were identified as most promising candidates for classical biological control: *Ganaspis brasiliensis* (Ihering), *Leptopilina japonica* Novković & Kimura (Hymenoptera: Figitidae), and *Asobara japonica* Belokobylskij (Hymenoptera: Braconidae) (Daane et al. 2016; Girod et al. 2018a, Giorgini et al. 2019).

Laboratory-based studies showed that from these major parasitoids, *G. brasiliensis* has the highest host specificity to *D. suzukii* (Girod et al. 2018b, Biondi et al. 2021). This parasitoid has a wide geographic distribution (Asia, Central-, and South America) but has been subdivided into five genetic groups (named G1-G5). Particularly G1 and G3 seem to be specialized to *D. suzukii*, however, laboratory-based studies show that G3 also readily attacks non-target *Drosophila* species. Besides the differences in host-specificity, additional genetic analyses and crossing experiments suggest the existence of cryptic species within *G. brasiliensis* (Seehausen et al. 2020).

### Most promising natural enemies for classical biological control



## Preparedness in biological control of priority biosecurity threats

G1 *Ganaspis* cf. *brasiliensis*: Was found during foreign explorations in Asia to be the most dominant larval parasitoid of *D. suzukii*. Laboratory trials confirmed that the genetic group G1 is specialized on attacking *Drosophila* larvae in undamaged fresh fruits, which should make it specific to *D. suzukii* in its invaded range (Seehausen et al. 2020). An adventive population of the parasitoid was found to be present in Canada, open field releases have been approved in the USA and conducted in Italy in 2021.

G3 *Ganaspis* cf. *brasiliensis*: Composed ~25-30% of all *G. brasiliensis* that emerged from *D. suzukii* during foreign exploration in Asia. The parasitoid successfully attacks non-target hosts belonging to the '*D. melanogaster*-group' feeding on decomposing fruits. The G3 group is easier to rear than G1 because it also attacks *Drosophila* larvae feeding on artificial diet.

*Leptopilina japonica*: Shown to be a dominant parasitoid of *D. suzukii* in Asia but parasitizes several non-target *Drosophila* species in laboratory no-choice tests. Adventive populations of this species were found in Canada, where it co-exists with *G. brasiliensis* and imposes high mortality on *D. suzukii* (Abram et al. 2022). It was also found in northern Italy, where it is currently the dominant parasitoid of *D. suzukii*.

### Other natural enemies for classical biological control

*Asobara japonica*: During field surveys in Asia, the parasitoid showed high parasitism levels on either *D. suzukii* and several other *Drosophila* species (Daane et al. 2016). In laboratory studies, the parasitoid has been shown to have a too broad host range to be considered for classical biological control programs and the species has not been found yet in *D. suzukii*-invaded regions.

Few indigenous parasitoids effectively attack *D. suzukii* in its invaded regions. Two cosmopolitan and generalist pupal parasitoids, *Trichopria drosophilae* Perkins (Diapriidae) and *Pachycrepoideus vindemiae* (Rondani) (Pteromalidae) readily attack and develop from *D. suzukii* in the Americas and Europe. Although these pupal parasitoids can be effective under laboratory conditions, field parasitism of SWD pupae is generally < 5%.

### References

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