

How Seasons Affect Population Structure, Behavior and Risk on Spotted-wing Drosophila

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Seasonal population structure and reproduction

Most spotted-wing drosophila (SWD) that survive the winter do so as adult females. Winter morph females mate during fall, store the sperm over winter, and infest the first ripening fruits in early spring. As temperatures fall below 50°F (10°C), few SWD females carry eggs and the population decreases. When temperatures rise above 50°F (10°C) for periods longer than five days, the fertilized eggs within SWD females start to mature and the population begins to increase above the overwintering level (see Figure 1, page 2).

When temperatures reach 64°F (18°C), adult females lay more eggs (Figures 1 and 2, page 2). Eggs hatch into larvae, which develop into pupae and then adults at increased rates as temperatures climb during the summer. As the season progresses, it is possible for the generations to overlap, resulting in a relatively stable distribution among different life stages (egg, larva, pupa, adult). In Oregon, approximately 90% of all life stages are eggs, larvae and pupae during this period, with only 10% in the adult life stage (Figure 3, page 2).

One reason SWD is so difficult to manage is that eggs, larvae and pupae are well protected within the fruit or in the soil. Also, a steady stream of adults reaches reproductive maturity and attacks the crop. When average daily temperatures drop below 50°F (10°C) or increase above 82°F (28°C), SWD become less active and reproduce at lower rates. However, the insect

Key points in this fact sheet

- *Spotted-wing drosophila (SWD) are less active during cold winter months, and mostly survive as adult females during this period.*
- *SWD exist as adult in two morphs or body types. In cold-winter climates, SWD adults can assume a larger, darker-colored winter morph or body type..*
- *When temperatures rise above 50°F (10°C) for more than five consecutive days, populations can increase.*
- *When mean daily temperatures are below 50°F (10°C) or above 82°F (28°C), SWD become less active and reproduce more slowly.*
- *As the growing season progresses, generations overlap, resulting in a relatively stable distribution among different life stages.*
- *There is a stable population structure during the growing season. During this time, populations consist largely of immature life stages that are protected inside fruit.*
- *During the growing season, the population structure consists of 90% eggs, larvae or pupae and 10% adults.*
- *During hot summer periods, most activity, including egg laying, occurs during dusk and dawn.*

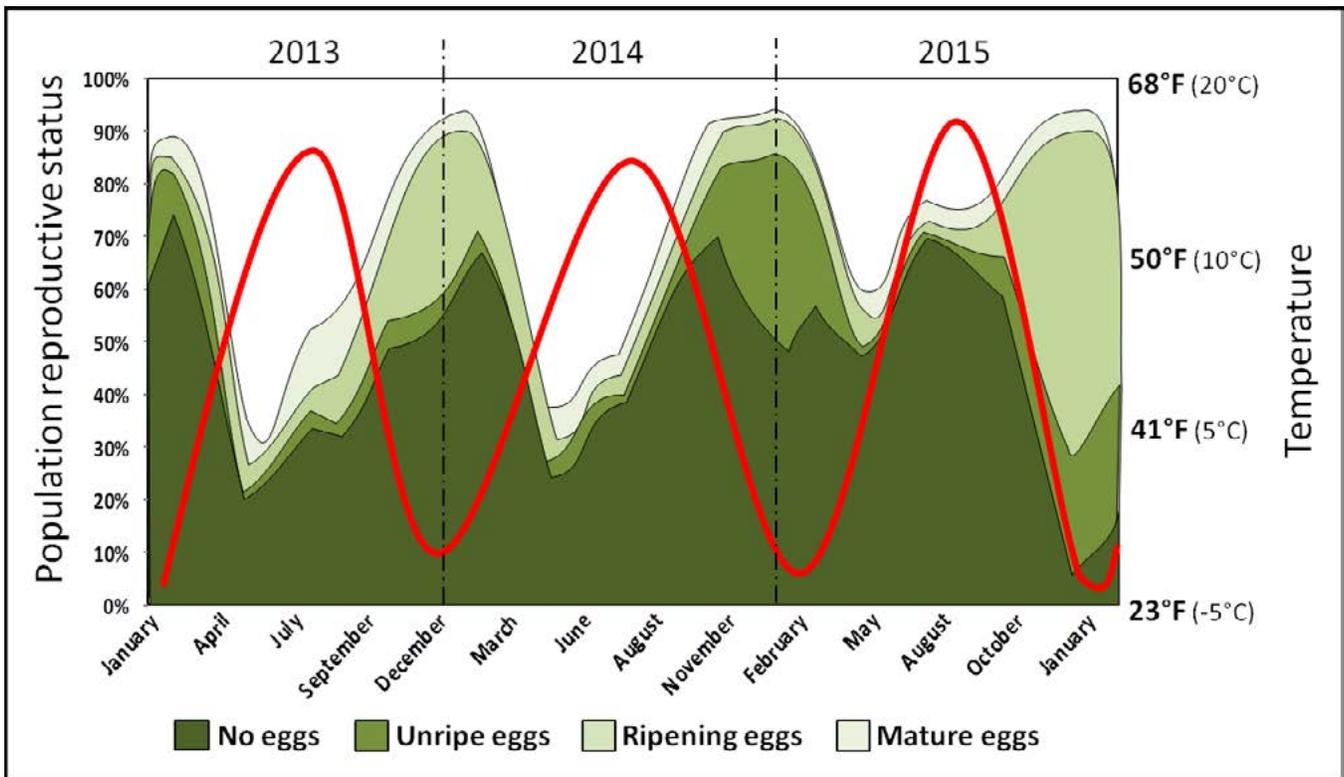


Figure 1. SWD reproductive biology during three consecutive years (2013–15). Different green shades represent the proportion of the different reproductive stages of SWD females at any time; specifics could vary in another region or growing season. The red line represents temperature. The population distribution illustrates a general trend; specifics could vary in another region. (Adapted from Grassi et al. 2018).

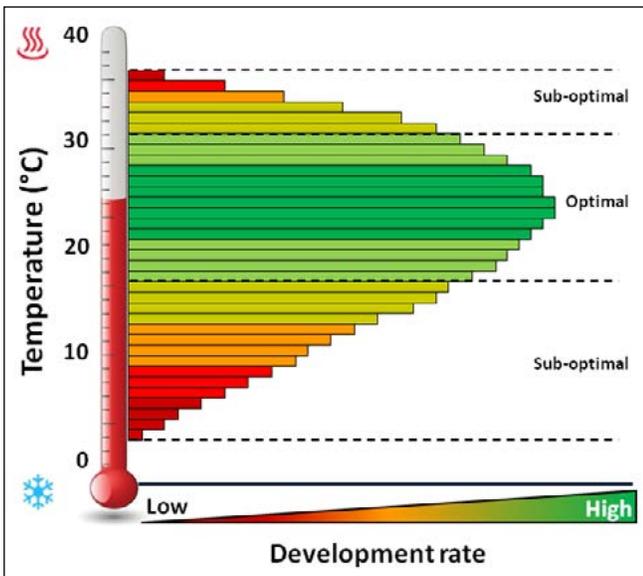


Figure 2. Lower and upper temperature thresholds of SWD (adapted from Tochen et al. 2014).

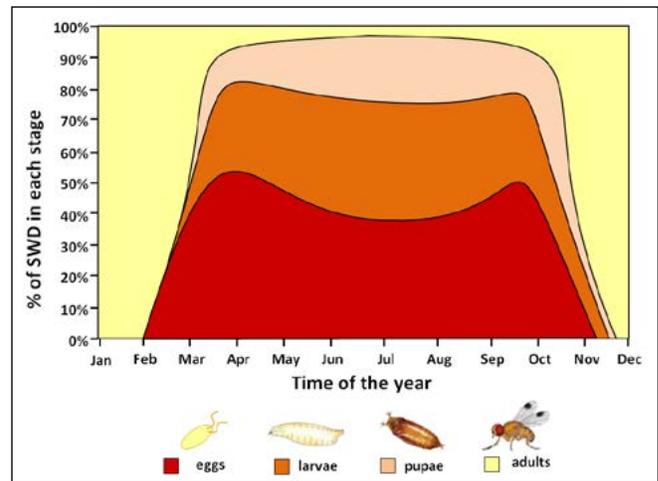


Figure 3. Generalized population structure of SWD through the growing season (adapted from Wiman et al. 2014). Notice that during the winter months, 100% of the population is overwintering as adults. During the growing season, much of that population is in the immature egg, larval and pupal stages and are protected within the fruit or in the soil. Adults are most susceptible to insecticide sprays.

can optimize its behavior to daily temperature cycles. During hot summer periods, the majority of activity, including egg-laying, occurs during the cooler dusk and dawn periods (Figure 4).

Further reading

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Rendon D., V.M. Walton, G. Tait, J. Buser, I. Lemos Souza, A.K. Wallingford, G. Loeb, J.C. Lee. 2019. Interactions among morphotype, nutrition, and temperature impact fitness of an invasive fly. *Ecology and Evolution* 9: 2615-2628. DOI: 10.1002/ece3.4928

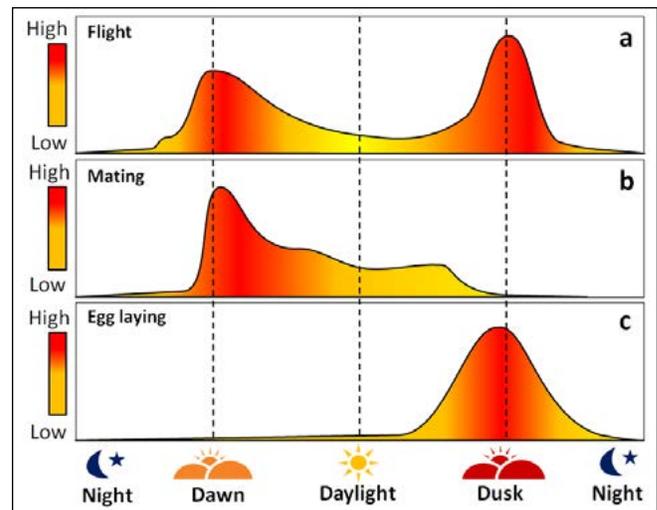


Figure 4. Daily flight (a), mating (b), and egg laying (c) activity of SWD during the growing season (adapted from Hamby et al. 2016). These behaviors are concentrated during cooler parts of the day, and diminish during the hotter parts of the day. All of these activities drop off during the dark because SWD uses vision to navigate and because its circadian rhythm causes it to rest during the night.

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