

Cold hardiness of *Trichopria drosophilae*, a parasitoid of *Drosophila suzukii*

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Abstract: *Trichopria drosophilae* (Perkins, 1910) (Hymenoptera: Diapriidae) is a pupal parasitoid of *Drosophila* recorded from several parts of the world. It is considered for augmentative biological programs to control the invasive agricultural pest *Drosophila suzukii* (Matsumura, 1931). To evaluate its establishment potential in temperate regions, we are investigating the low temperature tolerance of this species.



Material and methods

The strain of *T. drosophilae* was captured 2017 in Zürich.

The Super Cooling Points (SCPs) were determined by type-T copper-constantan thermocouples. Unfed 2-day-old adult *T. drosophilae* were tested (Fig 1).

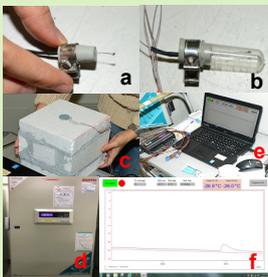


Fig 1- SCP process: a. *T. drosophilae* attached to the thermocouple needle, b. Threaded in a sealed microcentrifuge tube, c. Placed in a 20-cm polystyrene cube, d. The cube was placed in a -80 °C freezer, which cooled the insect at ~1 °C /min, e. Body temperature was recorded, f. SCP read as the lowest temperature reached before freezing.

To assess cold hardiness, individual unfed 2-day-old adults from three drosophilid hosts: *D. suzukii* (DS), *D. melanogaster* (DM) and *D. subobscura* (DO) were exposed for varying durations (from 1 h to 11 d) to constant low temperatures of 0, -5 and -10°C (Fig 2). Prior and subsequent to the exposure, adults were acclimatized for 6 h at 10°C for prohibiting cold stress.



Fig 2- Cool boxes used for cold hardiness experiments

Results

SCP results showed that critical thermal minima were -27.3 ± 0.78 (mean \pm SEM) for males and -27.2 ± 0.77 °C for females.

Adults exposed to -10 ± 1 °C showed 100% mortality after 24 h of exposure. Hourly mortality rate at -10 ± 1 °C increased with time of exposure between 1 h and 6 h. At 0 °C and -5 °C, no adult survived 11 days of exposure (Fig 3). Cooled females at 0 or -5 °C could reproduce after 5 d exposure. So far no clear pattern is visible for the influence of different hosts on *T. drosophilae* cold hardiness.

Discussion

Identifying environmental constraints that affect the geographic distribution and abundance of natural enemies is fundamental for their effective use. According to our results, adults of *T. drosophilae* can survive short periods of extremely low temperatures. However, long term exposure at 0 °C for 11 days is lethal. Since under unfavorable winter conditions in Zürich, temperature may drop below 0 °C for longer periods, adults are probably not the overwintering stage.

Outlook

An ongoing experiment addresses winter survival of different life stages of *T. drosophilae* under outdoor weather conditions, and will be complemented by laboratory tests with subadult stages.

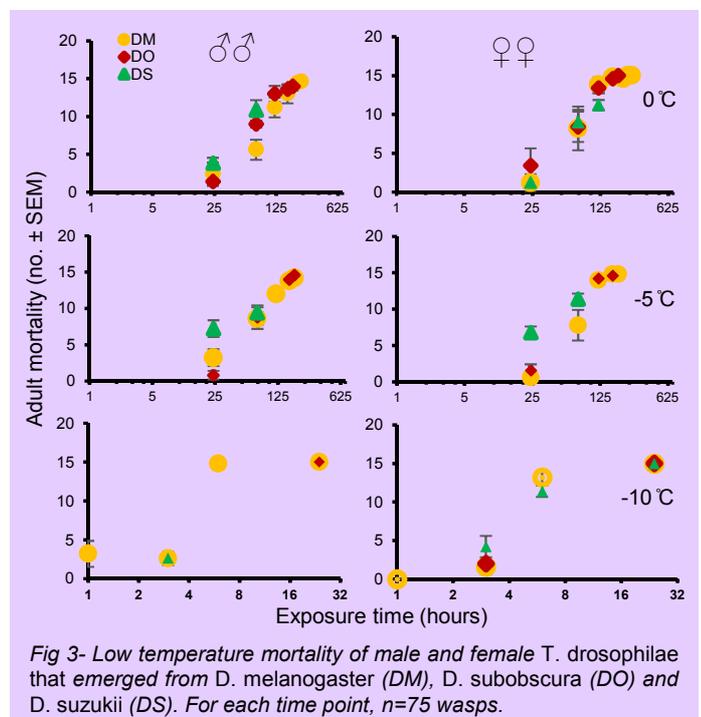


Fig 3- Low temperature mortality of male and female *T. drosophilae* that emerged from *D. melanogaster* (DM), *D. subobscura* (DO) and *D. suzukii* (DS). For each time point, $n=75$ wasps.