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How low can you go (and live): Determining the sub-lethal exposure time to desiccation in snowberry maggot flies (Rhagoletis zephyria)

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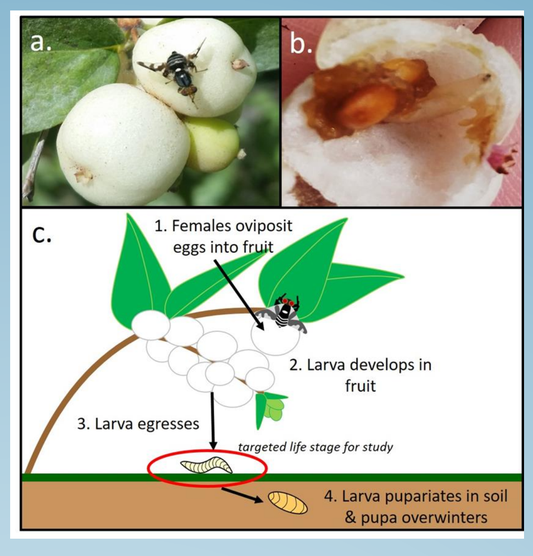
Introduction

- The fruit infesting snowberry maggot (*Rhagoletis zephyria*) inhabits a broad range of habitats across the northern United States, including the humid and arid parts of Washington State (WA)
- Larvae are vulnerable to desiccation in between leaving their host fruit and pupation
- Previous experiments have shown that there is a difference in desiccation resistance between western and central WA flies at eight days after the larvae emerge from the fruit
- The purpose of this experiment was to investigate when these differences first appear



Objective

Identify the time at which differences in desiccation resistance first appear between western and central WA populations of *R. zephyria*

Figure 1a-c. Life stages of *R. zephyria,* a. Adult resting on host fruit (snowberry) , b. Developing larva in host fruit, c. Stages of development. The transition from soft-bodied larva to protected pupa is thought to be most sensitive to desiccation.
Figure credit: Christa Kohnert

Methods

- Larvae were obtained from infested snowberry fruit from both Bellingham (western WA) and Umtanum (central WA)
- Larvae were collected on day 0 (the day the larvae emerged from the fruit), weighed, and randomly assigned to one of 6 cohorts: 0 (Bellingham control only), 1, 2, 4, 8, or 16 days of low relative humidity treatment (43% RH)
- Larvae were weighed and "rescued" (placed into high relative humidity treatment (100% RH)) based on random cohort assignment. 8 day and 16 day weights were taken for all cohorts.
- All larvae were placed in high RH for overwintering at the end of the experiment.

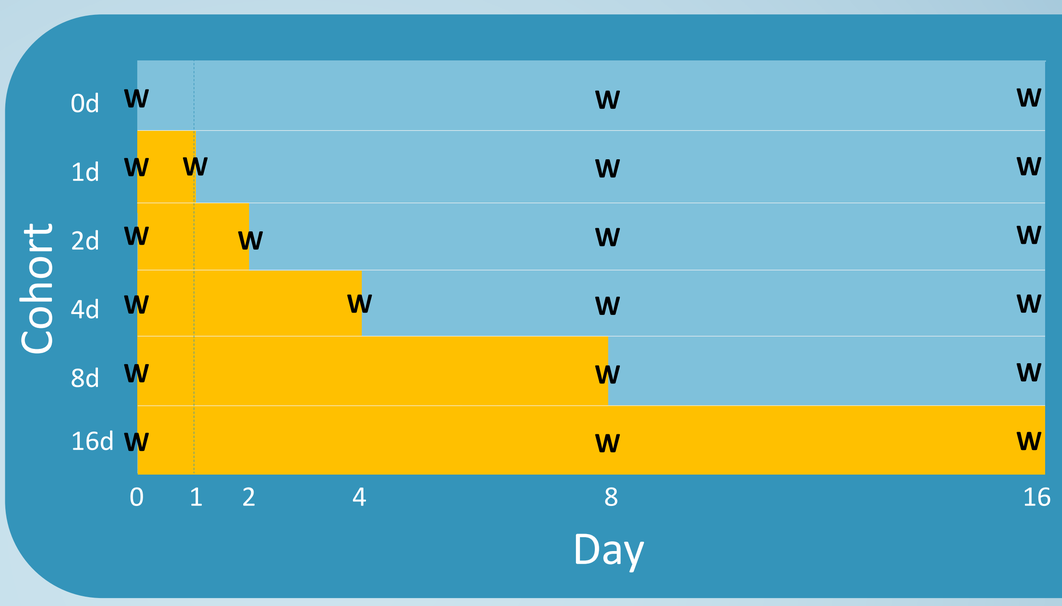


Figure 2. Treatment cohorts (0 day, 1 day, 2 day, 4 day, 8 day, and 16 day) vs. time. Colors represent relative humidity treatment (blue= 100% RH, orange= 43% RH). All samples weighed at day 0, day 8, and day 16, as well as the last day of low RH treatment (determined by random cohort assignment).

Results

Differences in water loss between western and central WA pupae arise as early as day 1 of treatment

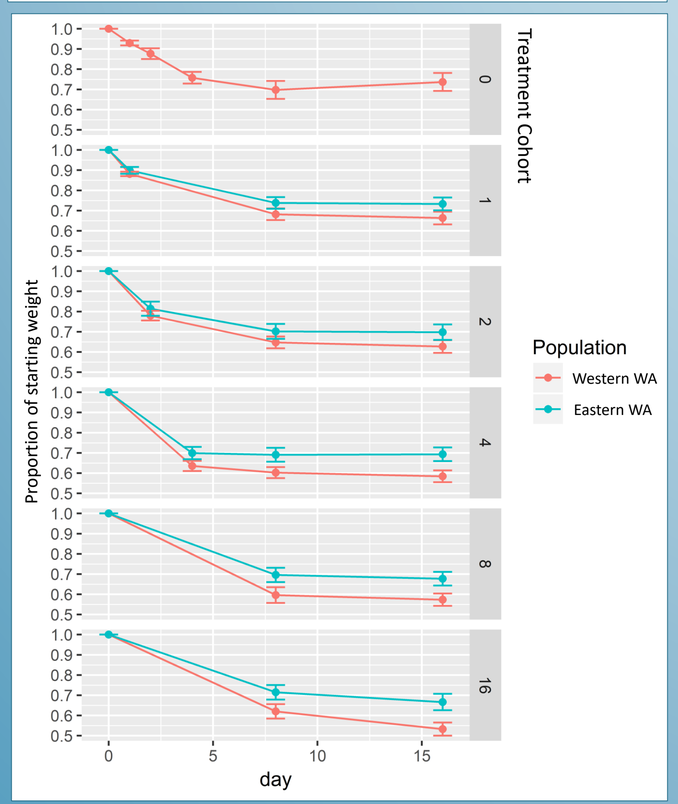


Figure 3. Proportional weight remaining cross all cohorts for the 16 day duration of the experiment. Lines represent population means, error bars represent 95% confidence intervals.

Duration of exposure to drought affects survival of western but not of central WA pupae

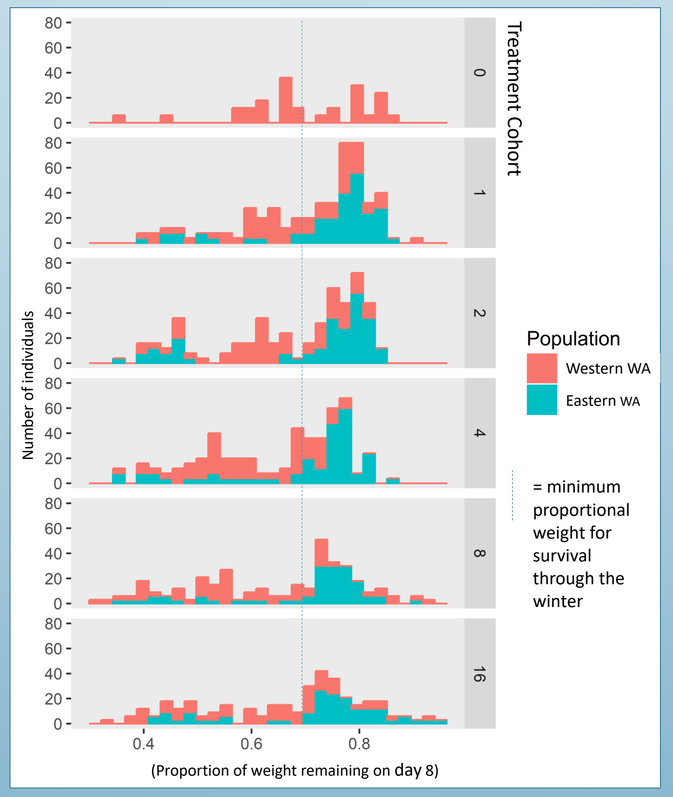


Figure 4. Proportion of starting weight remaining at day 8 of treatment across all cohorts. Dashed-line indicates the minimum proportional weight for survival through the winter.

High humidity rescue does not reverse the effects of early short–term desiccation treatment

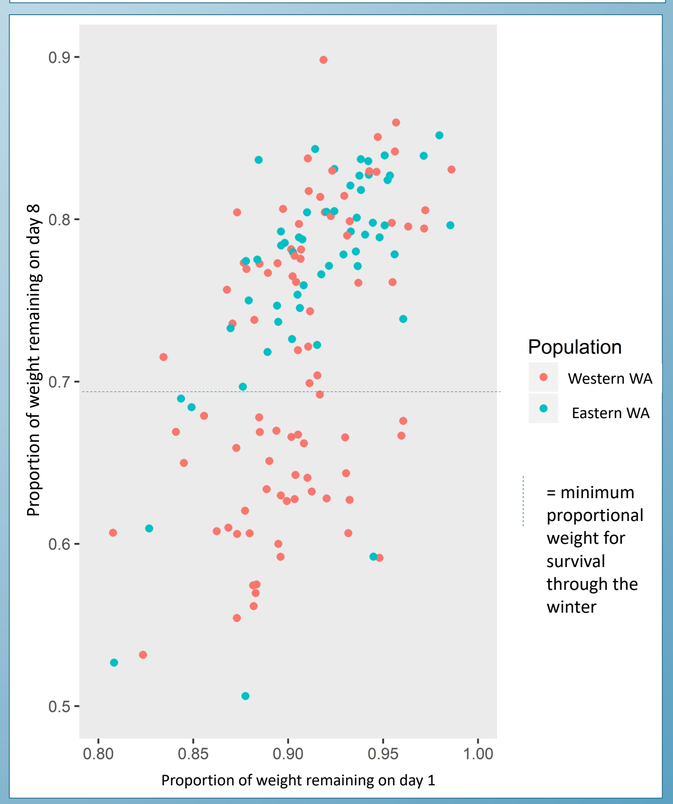


Figure 5. Proportion of starting weight remaining on day 8 (after 1 d 43% RH + 7 d 100% RH) vs. proportion of starting weight remaining on day 1 (after 1 d 43% RH) for individuals in cohort one.

Discussion/Future Research

- Future studies of the physiological and genetic mechanisms of differences in desiccation resistance should focus on the time period immediately after the larva has left the fruit.
- The difference in desiccation resistance between eastern and western WA *R. zephyria* populations likely represents local adaptation within the species. This indicates that western WA populations may be able to adapt to climate change by becoming more desiccation resistant.
- Desiccation resistant *Rhagoletis zephyria* individuals can hybridize with the related *Rhagoletis pomenella* (the apple maggot). This hybridization could create *R. pomenella* that are more drought tolerant, which could pose a threat to apple crop.

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