

Water deprivation resistance influenced by age, sex, and diet in *Bactrocera oleae*

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Background: Understanding the factors that influence the olive fruit fly's (*Bactrocera oleae*) (Rossi) (Diptera: Tephritidae) ability to resist water deprivation is crucial for pest management and ecology. This study investigated the significant main effects of age, sex, and diet, as well as their complex two-way interactions, on water deprivation resistance.

Methods: Water deprivation resistance (hours until death) was measured across 24 experimental treatment combinations (3 age groups × 2 sexes × 2 diets × 2 mating status = 24). ANOVA indicated significant main effects of age ($F(2, 23) = 121.21$, p -value < 0.001), sex ($F(1, 23) = 204.89$, p -value < 0.001), and diet ($F(1, 23) = 17.88$, p -value < 0.001). A Tukey post hoc analysis was applied to examine statistically significant differences between the treatments.

Results: Significant differences in water deprivation resistance were observed:

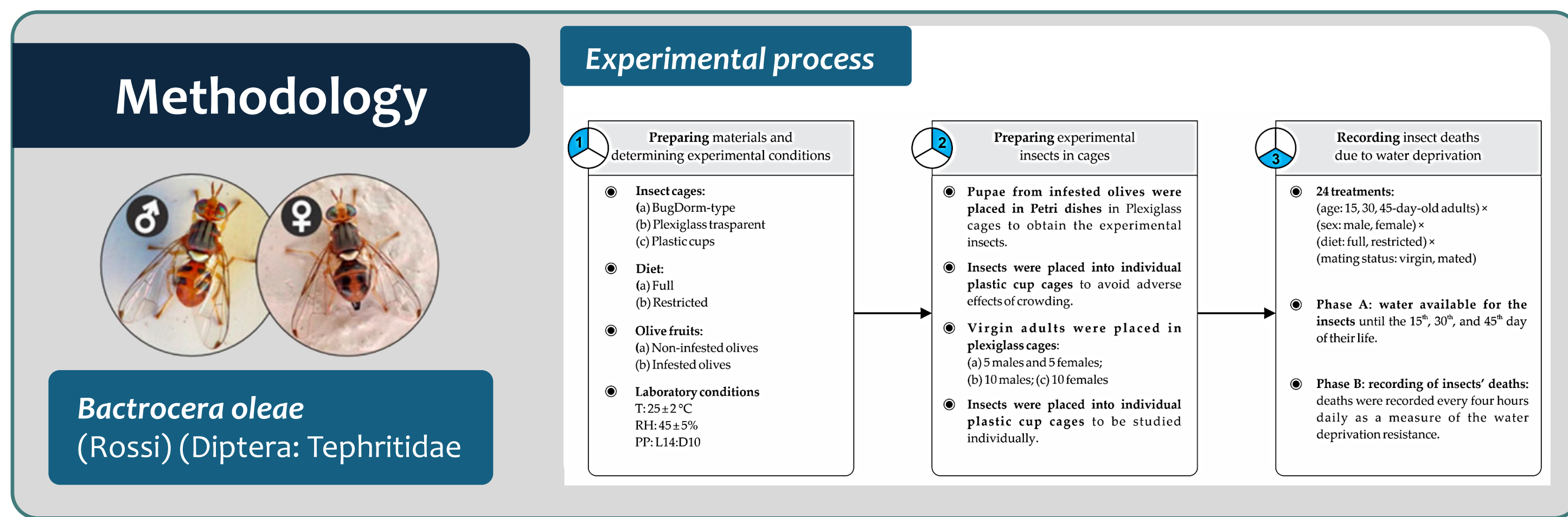
- **Female Superiority:** Virgin females (15 and 30 days old) generally had better water deprivation resistance than their male counterparts, regardless of diet. Similar superiority was noted in mated females on the restricted diet.
- **Age-Related Decline:** Water deprivation resistance decreased with increasing age across all treatments.
- **Diet & Mating Status Effect:** 15-day-old mated females on the restricted diet endured longer than those on the full diet.

The highest survival rate beyond the median (90 hours) was 96.67%, observed in 15-day-old virgin females on the full diet and mated females of the same age on the restricted diet. Survival beyond 90 hours was over 50% for all virgin females and all 15-day-old mated individuals.

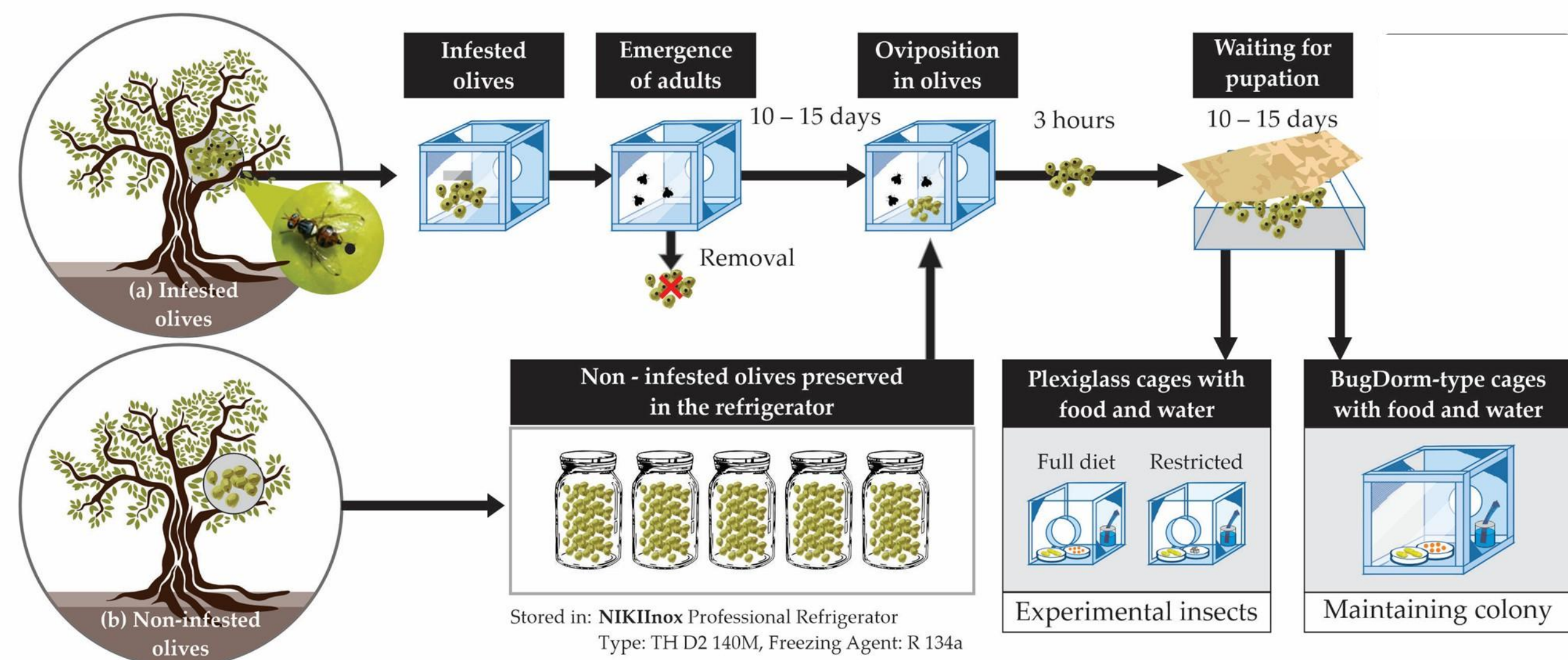
Conclusions: Sex and age had the greatest effect on water deprivation resistance. Female individuals, especially at younger ages and when virgin, demonstrated superior endurance to water loss. This complex interaction of factors is critical for predicting insect survival in arid or changing environments.

Keywords: survival; protein; sugar; olive crops; mating status

Session 1. Biology, Ecology, Physiology and Behavior

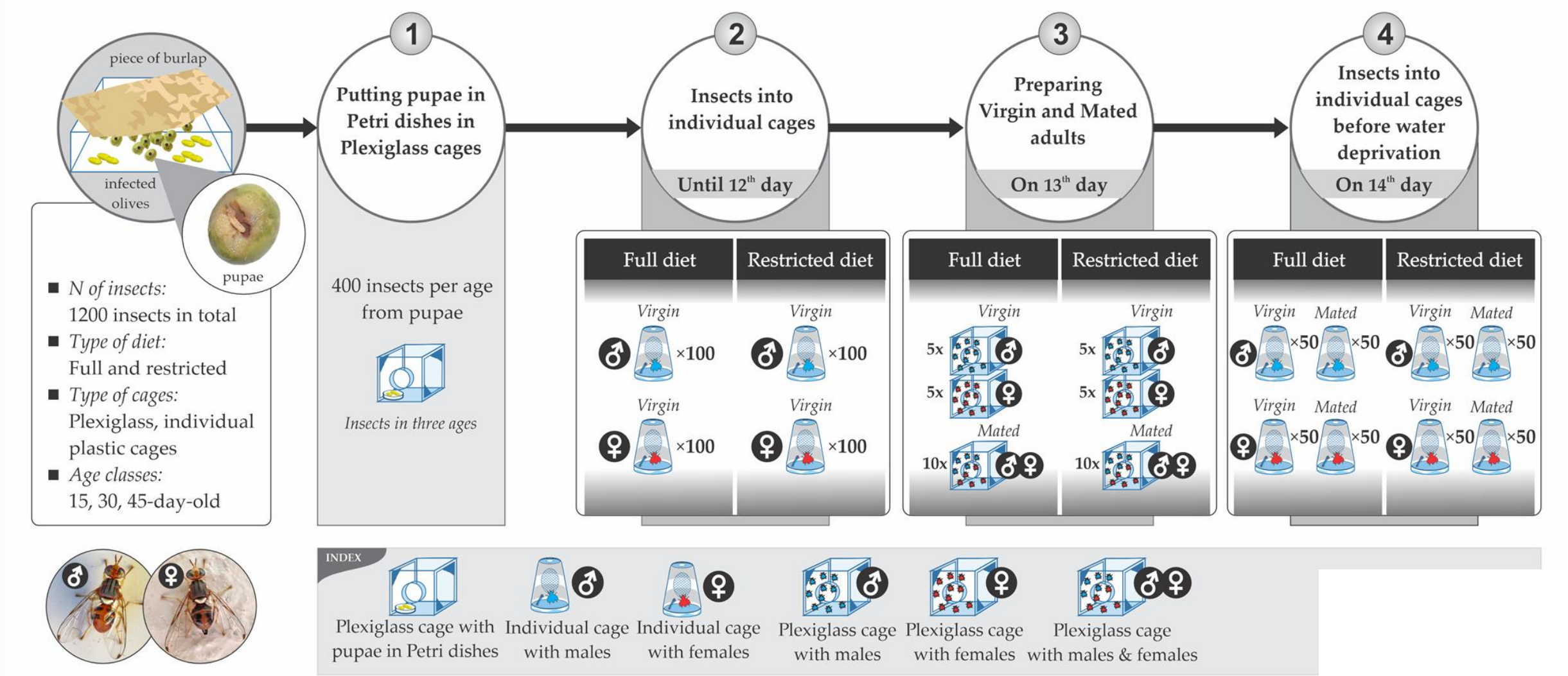


STAGE 1 Gathering infested and non-infested olives for the experiments

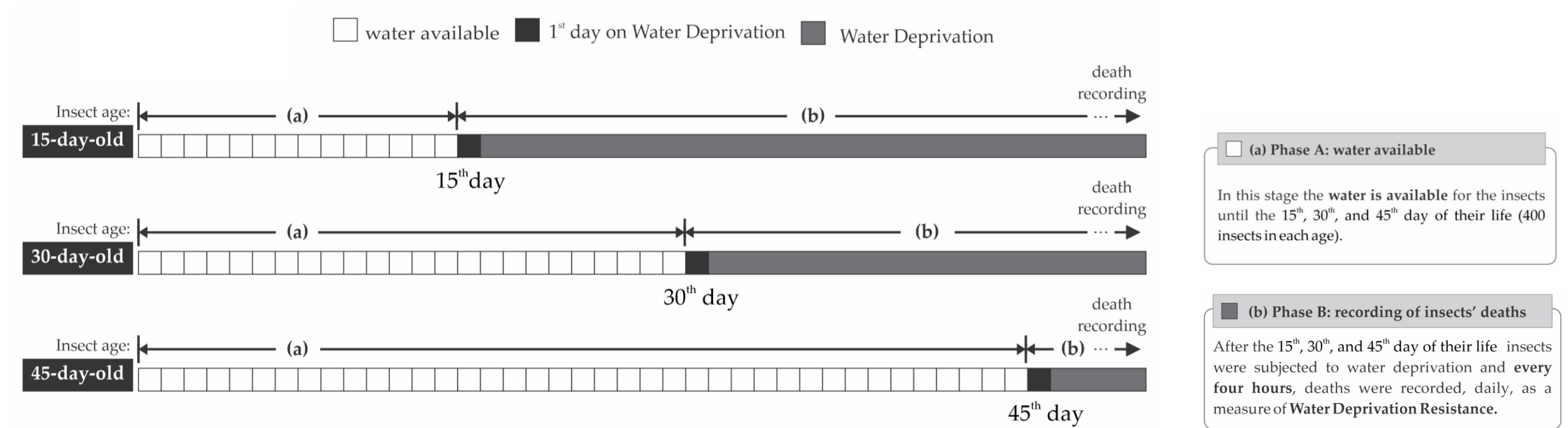


Larvae were reared in non-infested fruit from pest- and disease-free olive trees. From an initial population of 8,000 adults, 1,200 flies were utilized following mortality. The assessment of water deprivation resistance comprised two phases: (a) a period with access to water, and (b) a period of water deprivation during which mortality was recorded.

STAGE 2 Preparing the experimental insects in cages (4 steps)



STAGE 3 Recording of insect deaths as a measure of water deprivation resistance

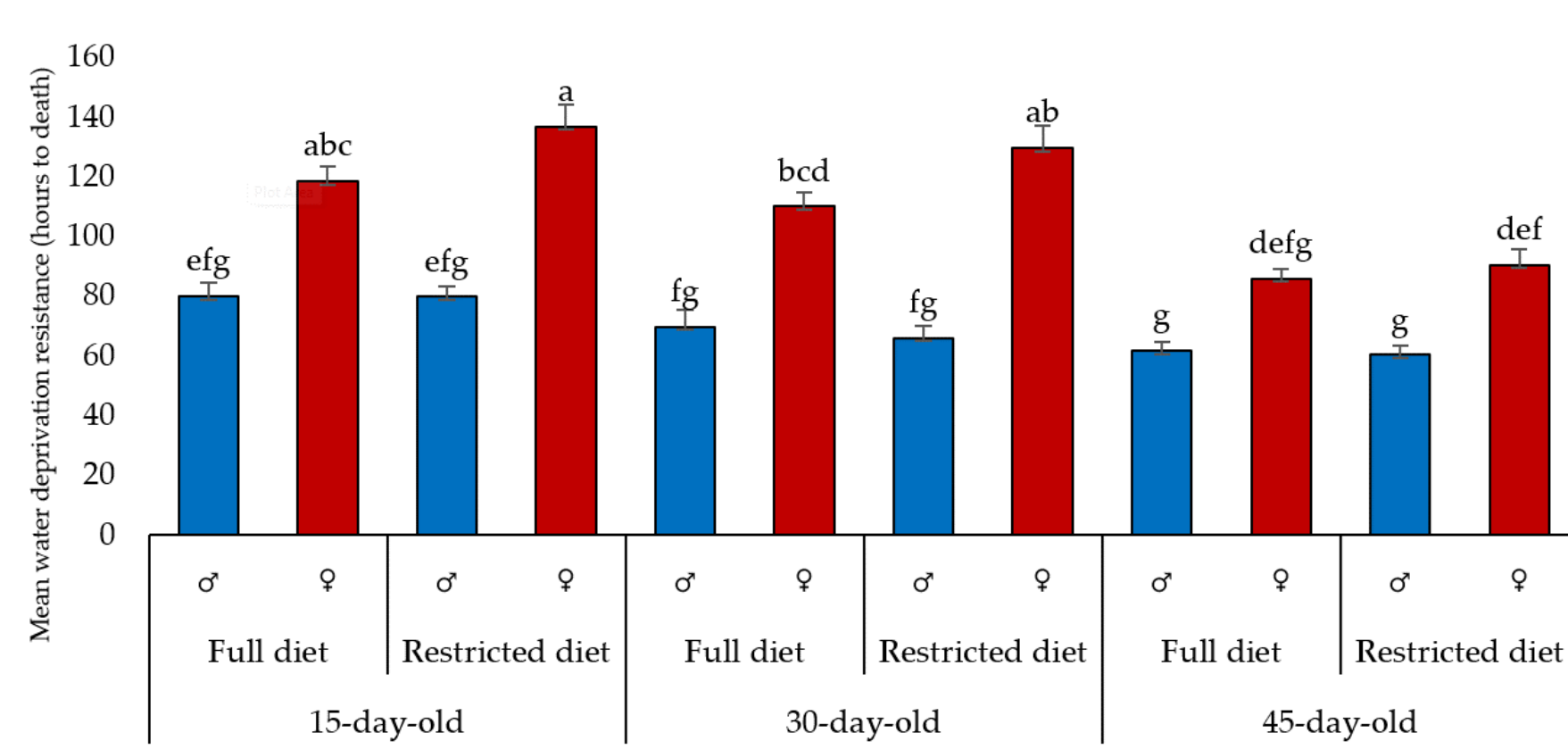


Schematic representation of the experimental design: (a) Phase A, water is available; (b) Phase B, recording of insect deaths every four hours daily as a measure of water deprivation resistance.

Results

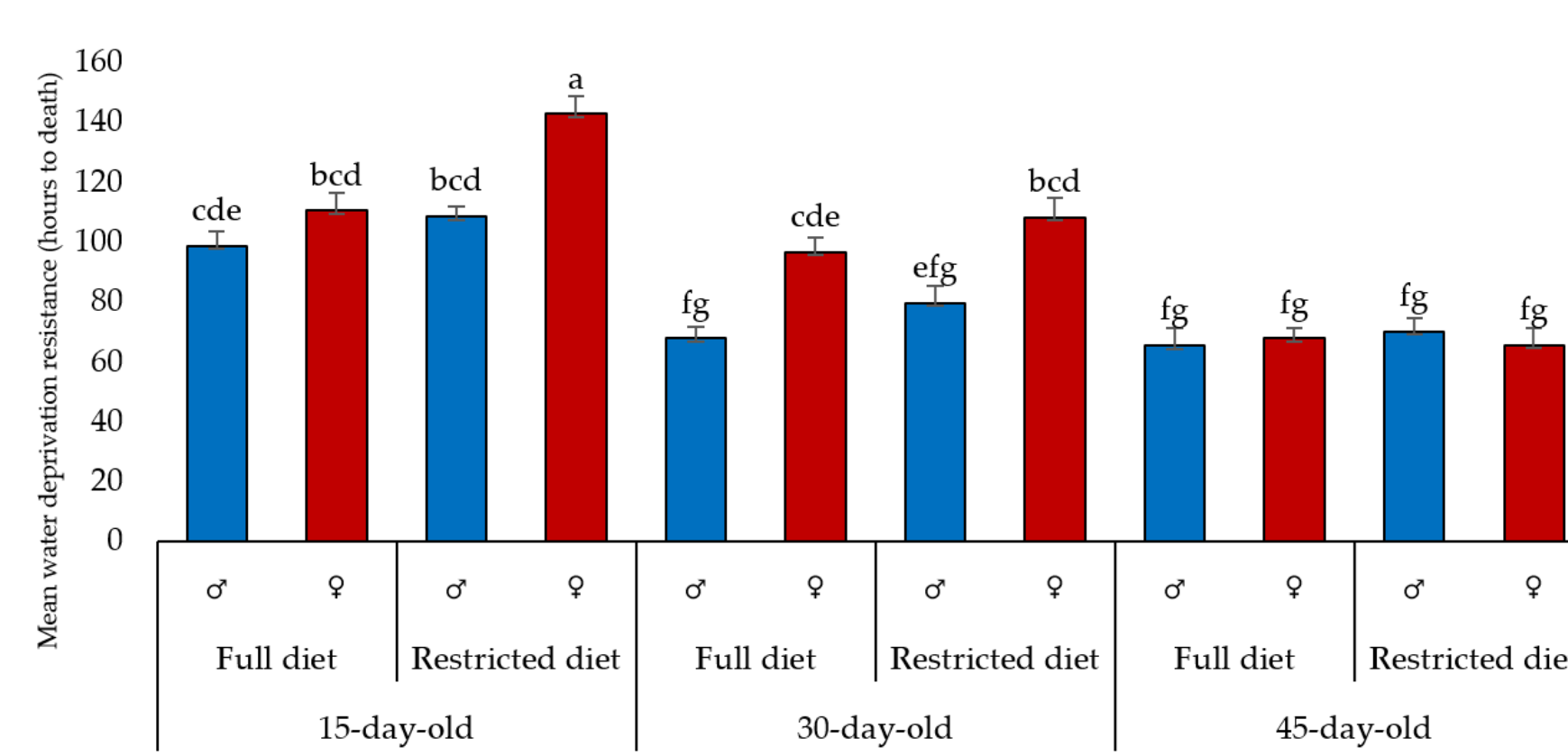
Virgin females (15 and 30 days old) demonstrated superior resistance to water deprivation compared to their male counterparts regardless of diet, though this resistance decreased as age increased. Among mated individuals, 15-day-old females on restricted diet showed the highest endurance, consistently outperforming males and exhibiting a decline in survival as they aged. Survival beyond the 90-hour median was highest (96.67%) in 15-day-old virgin females on full diet and mated females on restricted diet, remaining above 50% for all virgin and 15-day-old mated groups.

Water deprivation resistance for virgin males and females



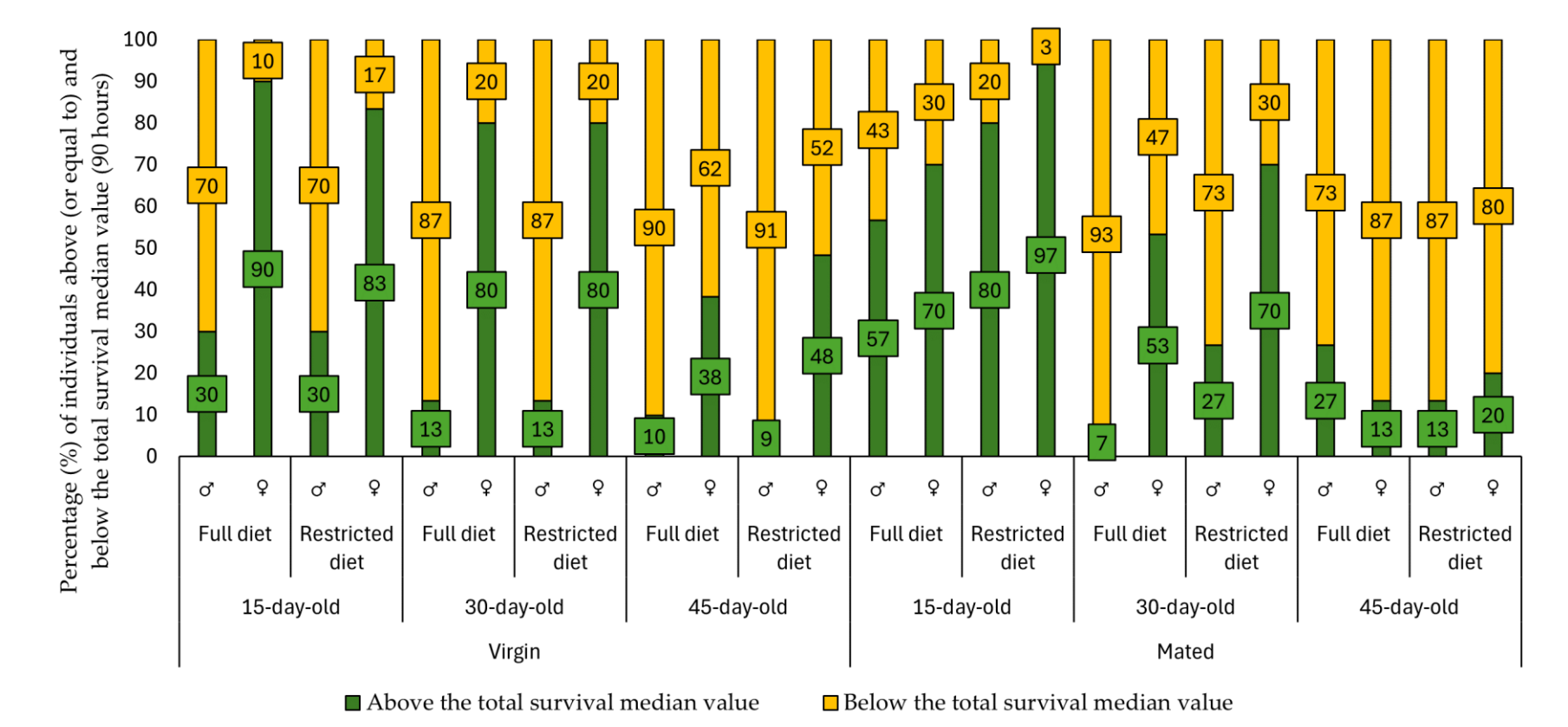
A. Water deprivation resistance (in hours to death) for virgin males (♂) and females (♀) at three different ages (15, 30, and 45-days old), in those fed the full diet and those fed the restricted diet. Lower-case letters above bars correspond to differences in mean values that are statistically significant at a significance level of $\alpha = 0.05$ ($p \leq 0.05$), according to the results of Tukey's test. Error bars correspond to standard errors of the mean values.

Water deprivation resistance for mated males and females



B. Water deprivation resistance (in hours to death) for mated males (♂) and females (♀) at three different ages (15, 30, and 45 days old), in those fed the full diet and those fed the restricted diet. Lower-case letters above bars correspond to differences in mean values that are statistically significant at a significance level of $\alpha = 0.05$ ($p \leq 0.05$), according to the results of Tukey's test. Error bars correspond to standard errors of the mean values.

Percentage of insect survival compared to the total survival median



C. Percentage (%) of virgin and mated individual males (♂) and females (♀) fed the full or restricted diet at three different ages (15, 30, and 45 days old) that survived water deprivation beyond or equal to and below the total survival median value (90 h).

Conclusions

Sex and age are the determining factors for the water deprivation resistance of *B. oleae*. Female individuals, particularly young and virgin ones, demonstrate superior endurance to water loss compared to males, with survival beyond 90 hours reaching 96.67% in specific groups. This resistance declines as age increases, and understanding this complex interaction between sex, age, and diet is vital for predicting population survival in water-deprived environments.



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