Too Hot to Handle: Effects of Temperature on Water Balance in the Alfalfa Leafcutting Bee *(Megachile rotundata)*

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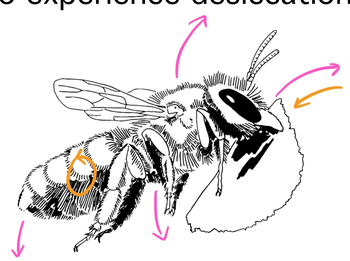
INTRODUCTION

- Alfalfa Leafcutting bees (ALCBs) are a heavily managed species of solitary cavity-nesting bee
- ALCBs overwinter as pre-pupa and experience desiccation from cold temperatures; it is likely that adults also experience desiccation in the field



How does temperature affect water balance and desiccation tolerance in ALCBs?

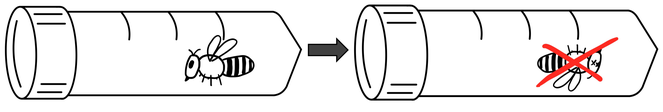
- Temperature impacts water balance
- Insects will die faster at higher temperatures at 0% RH; bees are more likely to turn on evaporative cooling measures and use body water to cool down at high temperatures

METHODS

Critical Water Content

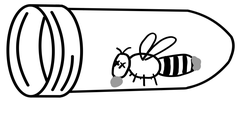
$$CWC\ (\%) = \frac{(wet\ mass\ at\ death\ -\ dry\ mass)}{initial\ total\ body\ water} \times 100$$

Masses measured each hour until death



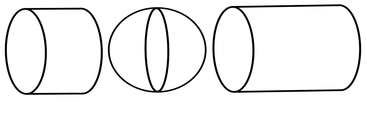
Cuticular Permeability

$$CP = \frac{\Delta\ H_2O}{2(SA * VPD)}$$



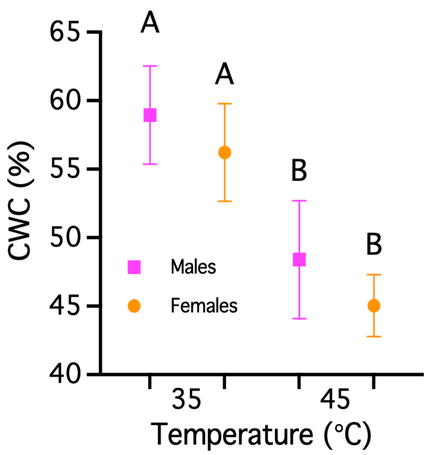
Surface Area:

$$SA\ (Males) = [2\pi r(r+h)] + [4\pi r^2] + [2\pi r(r+h)]$$



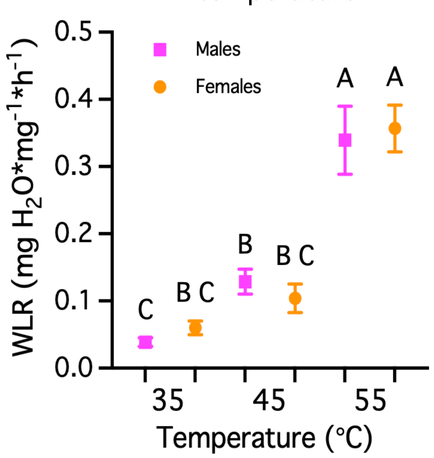
RESULTS

Critical water content decreases with temperature



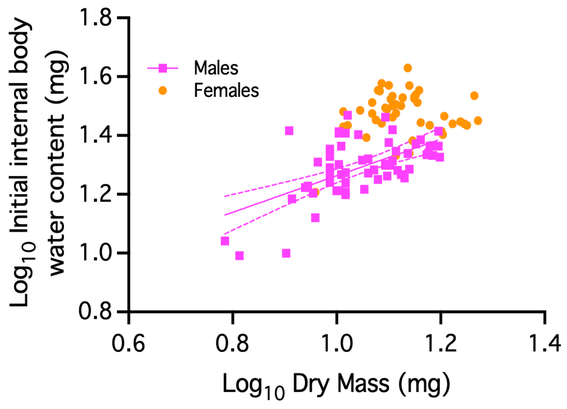
One-way ANOVA: $F(3, 56) = [15.91]$, $p < 0.0001$.

Water loss rate increases with temperature



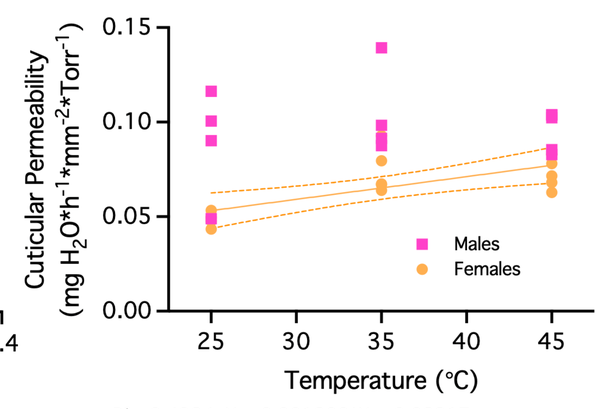
One-way ANOVA: $F(5, 101) = [61.74]$, $p < 0.0001$.

Male body water content scales hypometrically with dry mass



Males: Log_{10} IBW = 0.62*Log_{10} Dry Mass + 0.64, R^2 = 0.34, n=59, $p < 0.0001$. **Females:** Log_{10} IBW = 0.11*Log_{10} Dry Mass + 1.35, n.s., n=46.

Cuticular permeability increases with temperature



R^2= 0.4924; Y = 0.001200*X + 0.02317

DISCUSSION

- Water loss rate increases with temperature
- Mean mass-specific WLR at 55 °C was 0.35 mg H_2O/mg*h, 7-fold higher than water loss at 35 °C
- Mass-specific WLR varied between sexes at 35 °C and 45 °C, potentially due to differences in internal body water stores
- Females had more body water content overall (mean = 30.4 mg) and body water content did not scale with body size (dry mass)
- Larger bodied males had relatively less body water content (mean = 20.2 mg) when compared to smaller bodied males who had more body water content
- CP is significantly higher in females than in males potentially due to differences in cuticular composition

TAKE AWAYS

- Critical water content is temperature-dependent and corresponds with high water loss rates
- Female CP increases with temperature, but male CP is higher and not temperature dependent.

ACKNOWLEDGEMENTS

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REFERENCES

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