Thermal stress exposure of pupal oriental fruit fly has strong and trait-specific consequences in adult flies

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Abstract

Global climate change is projected to increase the incidence of heat waves, their magnitude and duration resulting in insects experiencing increasing environmental stress in both natural and managed ecosystems. While studies on insect thermal tolerance are rapidly increasing, variation across developmental or juvenile stress cross-stage effects within and across generations remain largely unexplored. Yet in holometabolous insects, heat stress at an early developmental stage may influence performance and survival during later stages. Here, we investigated the effects of pupal mild heat stress on the performance of laboratory-reared adult *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) measured as longevity, critical thermal maximum (CT_{max}), critical thermal minima (CT_{min}), heat knockdown time (HKDT) and chill coma recovery time (CCRT). Pupal heat stress significantly influenced performance of *B. dorsalis* adults resulting in impaired longevity and heat tolerance (CT_{max} and HKDT) in both sexes with improved and compromised cold tolerance (CT_{min} and CCRT) in females and males, respectively. These findings highlight the role of juvenile stages in mediating stress responses at adult stages. For *B. dorsalis*, pupal heat stress largely compromised thermal tolerance implying that the species has limited potential to shift its geographic range in heat prone areas. Significant benefits in cold tolerance in females following heat stress may help in improving survival in the cold in the short-term despite restricted activity to the same traits in males. This study suggests that basal heat tolerance and not short-term compensatory thermal plasticity following heat stress may have aided the recent invasion of *B. dorsalis* in African landscapes.