Impacts of Repeated High Temperature Exposure and Nutrition Change on Thermal Tolerance, Metabolism and Metabolite Profiles in Green Peach Aphid (*Myzus persicae*)

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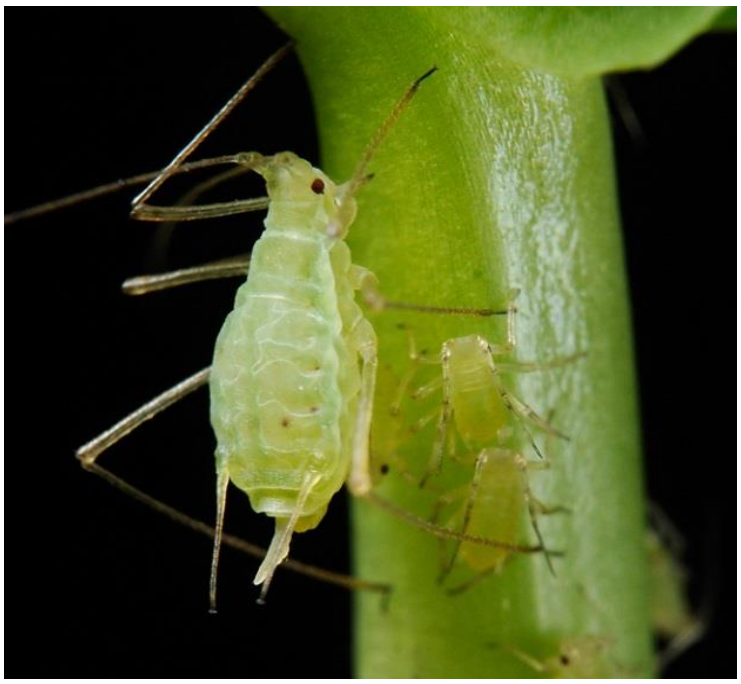

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Thesis Abstract

Insects are ectotherms and have limited ability to regulate body temperature above or below ambient, and as such they consequently greatly affected by temperature variation particularly heat stress. Since most insects will be exposed to increased heat stress with global warming it is important that we understand responses to an increasingly warm environment: especially the underlying changes in physiology and biochemistry. The few studies have assessed links between physiological mechanisms and impacts of repeated high temperature; identification of different recovery times and the role of nutrition in heat tolerance in aphids. The green peach aphid, *Myzus persicae* (Sulzer) (Hemiptera: Aphidae) is one of the major aphid pests infesting canola in Australia and is distributed widely across the globe, making it an ideal species for assessing the impacts of biotic and abiotic stress on its biology. The overall aim of this thesis was to use the model organism *M. persicae* to identify the roles of repeated high temperature exposure, nutrition and recovery time in thermal adaptation, and to asses this in a physiological context which included measuring key metabolite and metabolic rate, a postulated underlying process.

In chapter 2, I examined the physiological consequences of repeated high temperature exposure with recovery periods between these stress events in *Myzus persicae*. Aphids exposed to repeated pulses of high temperatures had more body glucose and higher expression of proteins and osmolyte compounds compared to the prolonged exposure group. However, aphids exposed to the repeated high temperature treatment had reduced sources of energy such as trehalose and triglyceride compounds than the prolonged exposure group. In addition, recovery time had more costs (based on production of more protein and consumption of more

trehalose and triglyceride) and benefits (based on production of more osmolytes) in repeated high temperature treatments.

In chapter 3, in the nutritional exhibited I carried out, aphids reared on the high amino acids medium increased heat tolerance and respiration rates compared to aphids reared on the low amino acid medium. Aphids reared on the diet with high amino acids and sucrose concentration had more glucose and higher expression of proteins and osmolyte compounds compared to those reared on a lower amino acid and sucrose diet. However, aphids reared on lower amino acids diets had reduced sources of energy such as trehalose and triglyceride compounds compared to high amino acid diets. These results indicate that aphid nutrition has a strong impact on the ability and plays a critical role in environmental stress responses.

In chapter 4, I demonstrated that trehalose and triglyceride are the most important sources of energy compared to glycogen in adult aphids when exposed to high temperatures. My findings indicate that adult aphids need different recovery time for different metabolite types.

Overall the findings from the research carried out as part of my thesis make a significant contribution to understanding the physiological mechanisms under high thermal tolerance; to the cellular process and key nutrition that facilitate thermal adaptation; and to the impacts of a changing and more variable climate on aphids.

Declaration of Authenticity

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis and all sources used have been acknowledged in this thesis.

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List of abbreviations

P	Prolonged heating treatment
R	Repeated heating treatment
M	Multiple heating treatment
C	Control treatments
CT_{max}	Critical temperature maximum
CT_{min}	Critical temperature minimum
FTR_s	Fluctuating temperature regimes
LONG	Long recovery treatments
MIXED	Mixed recovery treatments
SHORT	Short recovery treatments
AA150Su1000	Amino Acid 150 + Sucrose 1000
AA150Su250	Amino Acid 150 + Sucrose 250
AA50Su1000	Amino Acid 50 + Sucrose 1000
HSPs	Heat shock proteins