SEX-SPECIFIC EFFECTS OF DDT RESISTANCE IN FLIES

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To the University of Exeter as a thesis for the degree of Doctor of Philosophy in

Biological Sciences

November 2012

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

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ABSTRACT

In *D. melanogaster*, resistance to DDT is conferred by the upregulation of a cytochrome P450 enzyme, CYP6G1. Resistant flies have tandemly duplicated *Cyp6g1* alleles that possess the LTR (Long Terminal Repeat) of an *Accord* retrotransposon inserted in the cis-regulatory region, 291bp upstream of the transcription start site. This DDT resistance allele (DDT-R) has been shown to have pleiotropic fitness benefits for female flies in at least one genetic background and with evidence of sexually antagonistic selection at this locus. In this thesis, I first review the role of transposable elements in conferring insecticide resistance and the evidence to date regarding the pleiotropic effects of DDT-R in *D. melanogaster*. By conducting life history and behavioural tests on flies of two genetic backgrounds I examine the sex-specific effects of expressing DDT-R in the absence of DDT. Finally I develop a single locus population genetics model based on these sex-specific effects and test the model using replicate laboratory populations.

The first main finding is that DDT-R incurred a male mating cost that depended on the genetic background in which DDT-R was found and that this cost coincided with strong epistasis between genetic background and DDT-R that influenced male size (Chapter 3). Following on from this result, it was confirmed that the effect of DDT-R on male size does contribute to lowered mating success but does not fully explain this fitness cost (Chapter4). Additionally, resistant males were found to have a lowered rate of courtship behaviour driven by aborted chasing of females and lower male-male aggression than susceptible males (Chapter 4). Fitness assays in wild caught strain females revealed that DDT-R confers a fecundity increase but unlike previous work, no offspring viability increases were detected (Chapter 5). Thus as with male costs, specific pleiotropic female fitness benefits to resistance depend on genetic background. Modelling of DDT-R using a simple single-locus approach (Chapter 6) provides, for the first time, a unifying explanation for past and present DDT-R frequencies in nature and in old laboratory populations. The model is consistent with an old origin for the original DDT-R mutation held at low equilibrium frequency through balancing selection of a sexually antagonistic nature. It is also consistent with continued near fixation of DDT-R long after discontinued use and matches empirical observations in laboratory populations of the Canton-S background.

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