Effect of nutrient limitation on the Mediterranean flour moth, *Ephestia kuehniella* Zeller

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ABSTRACT

The Mediterranean flour moth, *Ephestia kuehniella* is a cosmopolitan pest of stored products that now has wide distribution in flour/feed mills in New Zealand. Understanding how individual behaviour and life-history strategies evolve in response to environmental variation will help predict the population dynamics and allow us to develop environmentally safe pest control measures.

This study investigated effects of food shortage and the responses this stimulated in *E. kuehniella.* I artificially created food stress environment by rearing *E. kuehniella* larvae at five different population densities of 50, 100, 200, 400 & 800 on a constant amount of diet (50 g). Population density had a detrimental effect on *E. kuehniella* fitness. At higher population density (800) due to food shortage larval period was prolonged, percent survival and pupal mass of both sexes decreased. Poor nutrition during the larval stage also effected adult morphology and reproductive output. Female fecundity decreased with increased population density. Females that developed at high population density (800) emerged with small head, thorax and forewing, but food stressed females developed large abdomens relative to their body mass. There were no significant changes in female ovipositor length in response to nutrient limitation indicating that under poor environmental conditions females allocate more resources to reproduction and in particular to traits that influence offspring. In males, head and thorax width decreased with increased population density. Males at higher population density had large forewings relative to their body mass, possibly to aid movement to new habitats. Genital traits were insensitive to food shortage resulting from crowding. Although males at population densities of 400 & 800 produced fewer eupyrene

sperm they had similar mating frequency and transferred similar numbers of apyrene sperm indicating that male development responds to juvenile environment. Males and females use visual and chemical cues to assess quality of potential mates during mate selection and prefer individuals that developed at high population density (800) compared to low population density (200) when their weights were matched, probably to obtain direct and indirect genetic benefits. *Ephestia kuehniella* obtains indirect genetic benefits through mate choice decisions. Body size has a heritable component and large parents produce large sons and daughters. Mother body mass influences offspring growth rate and daughter developmental period is shortened with increase in mother body mass but no such effect was observed on son developmental period indicating a non-genetic maternal effects. On the other hand, fathers do not have a notable influence on offspring growth rate and as a result the offspring of large fathers took longer to develop. Similarly, sons and daughters of polyandrous and cross culture females were heavier and polyandry increased female fitness especially in stressful conditions.

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This thesis consists of 8 chapters — General Introduction (Chapter 1), six experimental chapters (Chapters 2–7) and a General Discussion (Chapter 8). Chapters 3–7 are formatted ready for submission to peer-reviewed science journals and Chapter 2 has already been published. For this reason, each chapter is a standalone with its own Abstract, Introduction, Materials and Methods, Results and Discussion and hence there is some repetition in the chapters. For every chapter the table and figure numbering refreshes but each chapter has distinct running header for clarity. A single combined reference section is presented after Chapter 8.

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