

**ENVIRONMENTAL INFLUENCES ON THE FLIGHT AND
MIGRATORY POTENTIAL OF *HELICOVERPA PUNCTIGERA*
AND *H.ARMIGERA* (LEPIDOPTERA: NOCTUIDAE).**

by

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DECLARATION

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

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



Marc Coombs

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CONTENTS

Abstract	viii
Chapter 1: GENERAL INTRODUCTION	1
1.1 Environmental influences on insect flight and migration	1
1.2 The biology and ecology of <i>Helicoverpa punctigera</i> and <i>H. armigera</i> in Australia	4
1.2.1 Taxonomy, distribution and pest status	4
1.2.2 Ecology of <i>H. punctigera</i> and <i>H. armigera</i>	5
1.3 References	11
Chapter 2: REPRODUCTIVE MATURITY AND MATING STATUS OF MIGRANT <i>HELICOVERPA</i>	18
2.1 Introduction	18
2.2 Methods	18
2.3 Results	20
2.4 Discussion	20
2.5 References	22
Chapter 3: AGE-RELATED FLIGHT AND REPRODUCTIVE PERFORMANCE	28
3.1 Introduction	28
3.2 Methods	29
3.2.1 Larval and adult rearing	29
3.2.2 Tethered flight methodology	30
3.2.3 Determining relationship between age and flight ability	30
3.2.4 Mating and flight ability	31
3.2.5 Adult food and flight ability	32

3.2.6 The influence of age and adult food availability on reproductive performance	32
3.3 Results	33
3.3.1 Flight and age	33
3.3.2 Pre-oviposition period, fecundity and longevity of flown moths	34
3.3.3 Mating and flight duration	35
3.3.4 Adult food availability and flight duration	35
3.3.5 Age-related reproductive performance	36
3.4 Discussion	37
3.5 References	42
 Chapter 4: FLIGHT SPEED, DISTANCE AND MORPHOMETRICS	 58
4.1 Introduction	58
4.2 Methods	58
4.2.1 Insect material	58
4.2.2 Morphometric parameters	59
4.2.3 Flight muscle to body weight ratio	59
4.2.4 Flight mill	60
4.2.5 Flight testing	60
4.3 Results	61
4.3.1 Morphometrics	61
4.3.2 Flight speed and distance	62
4.3.3 Flight distance and morphometrics	65
4.3.4 Flight muscle to body weight ratio in <i>H.punctigera</i>	66
4.4 Discussion	66
4.5 References	70

Chapter 5: GEOGRAPHIC VARIATION IN FLIGHT CAPACITY AND LIFE	
HISTORY TRAITS	85
5.1 Introduction	85
5.2 Methods	85
5.2.1 Insect material	85
5.2.2 Statistical analysis	86
5.3 Results	86
5.4 Discussion	87
5.5 References	89
Chapter 6: THERMOREGULATION AND FLIGHT THRESHOLDS	97
6.1 Introduction	97
6.2 Methods	98
6.2.1 Insect material for laboratory experiments	98
6.2.2 Pre-flight warm-up and thoracic temperatures during flight	98
6.2.3 Duration of pre-flight warmup, and thoracic and abdominal temperatures during tethered flight	99
6.2.4 Static tethered flight : <i>H.punctigera</i>	99
6.2.5 Tethered to cotton twine	100
6.2.6 Field measurement of thoracic temperature during free flight	100
6.2.7 The role of thoracic scales and hairs as thermal insulators .	101
6.2.8 Estimating heat storage relative to heat loss from warmup and convective cooling	101
6.3 Results	
6.3.1 Pre-flight warm-up and changes in T_{th} during tethered flight	101
6.3.2 Duration of, and proportion of moths, initiating	

pre-flight warmup	102
6.3.3 Relationship of T_{th} and T_{abd} to T_{amb} during tethered flight	103
6.3.4 Relationship of T_{th} to T_{amb} during free flight	104
6.3.5 Thoracic scales as thermal insulation	104
6.3.6 Heat storage relative to heat loss	104
6.4 Discussion	105
6.5 References	108
 Chapter 7: LARVAL DIET AND FLIGHT PERFORMANCE	 123
7.1 Introduction	123
7.2 Methods	123
7.2.1 Larval treatments	124
7.2.1.1 Experiment 1 - Larvae caged on plants in the field	124
7.2.1.2 Experiment 2 - Larvae fed excised plant material ..	125
7.2.2 Flight testing	125
7.2.3 Statistics	125
7.3 Results	126
7.3.1 Experiment 1	126
7.3.2 Experiment 2	126
7.3.2.1 Survival of immatures	126
7.3.2.2 Body size and preoviposition period	126
7.3.2.3 Flight performance	127
7.4 Discussion	128
7.5 References	131

Chapter 8: SEASONAL POLYPHENISM OF <i>H.PUNCTIGERA</i>	142
8.1 Introduction	142
8.2 Methods	143
8.2.1 Insect material	143
8.2.2 Life history parameters	144
8.2.3 Flight testing	144
8.2.4 Environmental parameters	145
8.2.5 Statistical analyses	145
8.3 Results	145
8.4 Discussion	147
8.5 References	150
Chapter 9: GENERAL CONCLUSIONS	160
9.1 General conclusions	160
9.2 Directions for Future Research.....	164
9.3 References	166

Abstract

This study examined the role of environmental factors in influencing the flight capacity of *Helicoverpa punctigera* (Wallengren) and *H. armigera* (Hübner) moths (Lepidoptera: Noctuidae).

Flight capacity of female and male moths were measured by means of a tethered flight technique. Flight capacity was found to be age dependent in both species. In *H. punctigera*, flight ability increased from the first night following emergence up to night 4, and was maintained at least until night 10. In *H. armigera*, a peak in flight capacity occurred on night 4, followed by a decline with increasing age. Long flying (> 5 hr duration) moths were evident in both species from the night following emergence. Attainment of reproductive maturity was rapid in both species, with 91 % of *H. punctigera* and 77 % of *H. armigera* ovipositing by night 3. Hence, the increase in flight capacity recorded for both species during early adult life is coincident with the onset of reproductive activity. Both species retain the capacity for extensive inter-crop and inter-regional movement throughout most of the reproductive phase of their adult lives. Neither successful mating or the absence of adult food sources influenced flight capacity during early adult life.

Throughout the study the rearing methodology employed was designed to minimise the effects of inbreeding depression and inadvertent selection of genotypes. This was achieved by maintaining a broad base of mating pairs (25 - 30) for successive laboratory generations of both species. All experiments were conducted with insect material that had been in culture for not more than four generations.

Determination of the reproductive maturity and mating status of migrant *H. punctigera* and *H. armigera* moths collected from light traps mounted on towers shows that migration occurs prior to the onset of initial egg maturation and prior to mating in both species.

On flight mills, *H. punctigera* moths maintained average flight speeds of 3.2 (males) and 3.6 (females) km hr⁻¹ and achieved maximum overnight (10 hr) flight distances of more than 60 km on night 4. *H. armigera* moths maintained average flight

speeds of 4.8 (females) and 5.2 (males) km hr⁻¹ and also achieved maximum overnight flight distances of more than 60 km. There was no correlation between body size or morphometric parameters with distance flown in either species.

Maintenance of *H. punctigera* and *H. armigera* populations, originating from different geographic localities, under uniform laboratory conditions revealed genetic variation for some life history traits and flight capacity. Genetic differences in preoviposition periods were detected among populations of both *H. punctigera* and *H. armigera*, and in flight capacity during early adult life among *H. punctigera* populations, and at peak flight capacity among *H. armigera* populations.

H. punctigera and *H. armigera* moths utilise a preflight warmup behaviour (wing shivering) to elevate thoracic temperature to a level at which flight is possible. Both species maintain thoracic temperatures of 20 - 32 °C during free flight at ambients of 12 - 30 °C. Preflight warmup duration is inversely related to ambient temperature. Both *H. punctigera* and *H. armigera* moths require 12 - 15 mins at ambients of 10 °C to elevate thoracic temperature to a level sufficient for flight. Neither species were able to initiate preflight warmup or maintain flight at ambient temperatures of less than 5 °C. The inability of adults to maintain flight at ambients of less than 5 °C may serve to limit flight in cold upper air at night. Endothermy (wing shivering) became energetically more expensive for both species as the difference between thoracic temperature and ambient temperature increased.

Differing larval diets were shown to phenotypically modify body size parameters, but did not influence flight capacity. Both species displayed wide plasticity in the size at which successful pupation occurred. The lower pupal weights that permitted adult emergence were approximately 24 % (91/372) and 37 % (153/413) of the maximum pupal weight recorded for *H. punctigera* and *H. armigera* respectively. Low thresholds and high plasticity of pupal weight may have evolved in response to conditions of high temporal variation of host plant quality and availability.

H. punctigera adults display polyphenic variation of life history traits and flight capacity in response to seasonal changes in temperature and photoperiod. Successive

generations of *H. punctigera* maintained in field cages, exhibited an increasing incidence of the following traits; increased time to first oviposition, increased forewing to body length ratios, and increased flight capacity. Expression of these traits may potentially serve to extend the range of migration for this species during autumn. The likelihood and significance of autumn migration in the seasonal redistribution of this species remains to be determined.