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ASPECTS OF THE LIFE CYCLE, BIOLOGICAL PERFORMANCE AND

QUALITY OF THE BLACK LYRE LEAFROLLER

'Cnephasia' jactatana (Walker)

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requirements for the degree of Doctor of Philosophy in Zoology

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ABSTRACT

The thesis answers the general question of whether the quality of artificially reared insect species should be based on performance tests for intended use or whether quality should be based on a more holistic biological approach. The empirical research is carried out using the lepidopteran leafroller '*Cnephasia jactatana*' (Walker).

The thesis defines biological performance and quality in terms of the success of an insect population in survival and reproduction and regards the laboratory environment as an artificial habitat that insects must colonise in order to survive and reproduce. Changes in biological performance that occurred during 12 successive generations of laboratory rearing were due to selection, acclimatisation and domestication and not adaptation. Artificial colonisation is theoretically successful within a limited range of environmental factors. As the inherent genetic variability of the founder population determines the resilience of the population to changes in performance, the ranges of environmental factors during colonisation should be wide to 'capture' much of the variability.

Using body size (weight) as an aspect of overall quality, the thesis presents evidence that the final instar larva of *C. jactatana* has a threshold mechanism (larval critical weight, L_{CW}) that determines pupal and adult size. There is a proportionate

decrease in weight from the maximum weight that a larva attains in the final instar (L_{MW}) to pupa (described as constant D_P) and to adult (D_A). There is a direct relation between the latent feeding period (period between attaining an L_{CW} and L_{MW}), L_{MW} , pupal and adult size, and the reproductive performance (fecundity). Within the experimental conditions diet quality, temperature, photoperiod and artificial selection had no effect on the larval critical weight, D_P or D_A , the larval threshold mechanism in *C. jactatana* is probably a mechanical trigger that initiates pupation. Diet quality, temperature and thermophotoperiods affected pupal size, adult size and reproductive performance. Photoperiod had no significant effects on size and reproductive performance. Positive assortative selections for slow development and low pupal weight significantly decreased pupal and adult size, and reproductive performance. Selection for fast development and heavy pupal weight for three generations had no significant effect on size or reproductive performance. Larval critical weight is demonstrated as useful to define quality indices and predict the performance of laboratory reared insects.

The general conclusion of the thesis is that insect quality should be defined more in terms of the success in survival and colonising ability rather than solely on the success for 'intended role' or 'fitness for use'.

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LIST OF ABBREVIATIONS

A_{cw}	Adult critical weight
A_w	Adult weight
D_A	Decrease in weight from larval maximum weight to adult
D_P	Decrease in weight from larval maximum weight to pupa
GPD	General purpose diet
L_{cw}	Larval critical weight
L_{MW}	Larval maximum weight
P_{cw}	Pupal critical weight
P_R	Pupation rate index
P_w	Pupal weight
S_A	Adult synchronism index
SBD	Sheep nut bean-based diet
S_P	Pupal synchronism index