The Effects of Sublethal Doses of *Helicoverpa armigera* Single Nucleocapsid Nucleopolyhedrovirus on *Helicoverpa armigera* (Lepidoptera: Noctuidae)

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ABSTRACT

The focus of nucleopolyhedrovirus (NPV) research has been directed toward lethal infections and the elimination of a pest population. Another aspect of NPV infection, and one that has received considerably less attention, is that surviving exposure to sublethal doses of NPV is frequently accompanied with a reduction in the fitness of the host. As such, sublethal effects of NPVs are thought to have an important impact on the ecology and population dynamics of a host population. Commonly observed sublethal effects include slower development time, reduced pupal mass and reduced reproductive capacity. The aim of this study was to investigate sublethal effects in third instar *Helicoverpa armigera* following exposure to sublethal doses of its NPV (HearSNPV). In addition, the impact of sublethal HearSNPV doses on the metabolic rate of the host was investigated. This parameter has not previously been used to characterise sublethal infections.

Sublethal effects were recorded in third instar *H. armigera* following exposure to an LD_{25}. This involved recording the duration of immature stage development and pupal mass of insects that survived exposure to HearSNPV. Fecundity was recorded in mating pairs in which treated male and female insects were paired with healthy partners of the opposite sex. The number of eggs laid by each mating pair was recorded daily and subsequently, the proportion of eggs that hatched determined. In addition, the sex ratio and survival of offspring of mating pairs in which one partner was treated were recorded. Both male and females that were exposed to HearSNPV exhibited a reduction in the duration of the immature stages, but no significant differences in pupal mass, when compared with untreated controls. Sex ratio and survival amongst offspring of these mating pairs were not significantly different to controls although the egg hatch amongst treated groups was notably lower than that of controls. Life tables were constructed for

each population and jackknife estimates of relevant parameters were statistically compared to aid in the evaluation of the success of each population. Comparison of life table parameters indicated that the control population was, on the whole, more successful than populations derived from mating pairs in which one partner was exposed to HearSNPV.

The metabolic rate was recorded in third instar *H. armigera* exposed to two sublethal doses, LD_{25} and LD_{75}, of HearSNPV. The metabolic rate was recorded daily for four days post treatment by closed system respirometry. The overall metabolic rate of treated insects was higher than that recorded in untreated controls. The metabolic rate of LD_{25} treatment survivors was maintained immediately after inoculation (i.e. the metabolic rate 1 and 2 days post treatment was similar to the metabolic rate of controls), but was significantly higher than that recorded in controls 3 and 4 days following treatment. Relative to controls, the metabolic rate of LD_{75} treatment survivors dropped significantly 2 days post inoculation, recovered 3 days post inoculation, and increased again 4 days post inoculation. The elevated metabolic rate observed in survivors may reflect the initiation of defence responses in the host, such as the mobilising of an immune response. The results suggest that exposure to sublethal HearSNPV doses are associated with significant metabolic costs.

Sublethal inoculation of *H. armigera* with HearSNPV was characterised by a number of changes in life-history and fitness characteristics. Specifically, these alterations included reduced development time, reduced fecundity, and elevated metabolic rates, relative to controls. Furthermore, the construction of life tables and the statistical comparison of life table parameters estimated by the jackknife technique proved to be a highly sensitive method for evaluating the impact of sublethal treatment on *H. armigera*. The results of the current study suggest that exposure to sublethal doses of HearSNPV has an important role in reducing the fitness, and consequently the success, of a pest population.