International Archive of Applied Sciences and Technology
Int. Arch. App. Sci. Technol; Vol 5 [3]September 2014: 36-38

[ISO9001: 2008 Certified Organization]
www.soeagra.co/iaast.html

IAAST
ONLINE ISSN 2277- 1565
PRINT ISSN 0976 - 4828

CODEN: IAASCA
ORIGINAL ARTICLE

Use of nuclear polyhedrosis virus (NPV) as a microbial insecticide against a polyphagous pest, *Helicoverpa armigera* (Fab.) [Lepidoptera: Noctuidae]

Vinod Kumari
B B D Govt. College, Chimanpura, Shahpur, Jaipur-302004

ABSTRACT
Laboratory tests were carried out to evaluate the effectiveness of nuclear polyhedrosis virus (NPV) against the different larval instars of *Helicoverpa armigera* (Hub.). Seven concentrations [1×10^2 - 1×10^8 polyhedral inclusion bodies (PIB)/ ml] were tested and made from a stock suspension of 1×10^9 PIB/ml of commercial NPV (Biovirus-H). the results indicated that early instars (1 and 2) were more susceptible to NPV, however the relative susceptibility declined with the age of the larvae. The last instars were resistant to NPV.
Keywords: nuclear polyhedrosis virus, microbial insecticide polyphagous pest, *Helicoverpa armigera*

Received 09/04/2013 Revised 12/04/2014 Accepted 23/07/2014

INTRODUCTION

Helicoverpa armigera (Hub.), the gram pod borer, is a serious polyphagous pest of several cultivated crops and has attained global importance as an alarming pest [5] and is reported to have developed resistance to chemical insecticides including the widely used pyrethroids [16]. A microbial insecticide nuclear polyhedrosis virus (NPV) of *Helicoverpa armigera* (HaNPV) has been used for the management of this pest during the last few decades with encouraging results [3, 4]. Since gram pod borer infestation includes all larval instars in nature, reliability in usage of commercial NPV will be achieved only with a better understanding of larval susceptibility to NPV. This prompted to study relationship between larval development and susceptibility to commercial virus formulations. Histopathological changes were also examined to investigate the sequential changes in the post-infected dated tobacco caterpillars.

MATERIALS AND METHOD

Nuclearpolyhedrosis Virus:
Commercial formulation of NPV, Biovirus-H (Biotech International limited, New Delhi) with 1×10^9 PIB's/ml concentration was used as a stock solution.

Test Insect:
The culture of *Helicoverpa armigera* was maintained on caster (*Ricinus communis*) leaves at 27±1^{0}C temperature and 70 ±5% relative humidity (R.H). However, the test insects were maintained on artificial diet (Nagarkatti and Prakash, 1974) in order to eliminate the natural occurrence of disease, if any.

Bioassay:
A bioassay was conducted using seven concentrations viz. 1×10^2, 1×10^3 ,1×10^4, 1×10^5, 1×10^6, 1×10^7 and 1×10^8 PIB's/ml prepared by serial dilutions of stock solution containing 1×10^9 PIB's/ml, with distilled water. Each treatment had three replicates with 10 larvae each. A control was also maintained on untreated diet in triplicate. 1,3,5,8 and 10 days old larvae (starved for 2h.) were fed on pre-impregnated artificial diet for 24h. and then transferred on fresh diet. Mortality was recorded after every 24h. of treatment for an extended period of 10 days. The cumulative mortality in 3 replicates were pooled together and corrected percent mortality was calculated using Abbott's formula [1] and data so obtained were then subjected to probit analysis [8].

RESULT AND DISCUSSION

Bioassay:
The LC_{50} obtained for 1,3,5,8 and 10 days old larvae were 1.09×10^3, 3.33×10^4, 2.23×10^6, 1.83×10^8 and 1.17×10^{10} PIB's/ml, respectively (Table1). It was observed that LC_{50} of 3,5 and 8 day old larvae were 305.63, 20458.71 and 1678899.08 times greater than that of one day old larvae. Similarly 3 day old larvae

were 66.93, 5493.18 and 3512036.98 times more susceptible then 5, 8 and 10 days old larvae, respectively. The probit line for 10 days old larvae had slope that was significantly lower than that of younger larvae. The shift in position of the probit lines reflected that the older larvae displayed greater variability in response to NPV. The decrease in 'a' value denoted an overall reduction in mortality due to NPV with increasing host age. The downward shift of the line resulted in an increase in LC50. The drop in 'b' value showed that the increase in mortality due to increased dosage decreased with host age. Similar quantitative differences in LD_{50}/LC_{50} values were observed between different age groups of *Trichoplusia ni* [2, 12], *S. litura* [10, 19], *Heliothis virescens* [9, 10, 11], *H.armigera* [21, 14], *H. punctigera* [18] and *Orgyia ericae* [22]. Evans [6] also reported that LD_{50} values for third, fourth and fifth instar larvae were 5, 50 and 250 times that of the second instar of *Mamestra brassicae*. Similarly, the second instar larvae of *S. litura* were reported to be 3.5-, 92- and 2314- fold more susceptible than the third, fourth and fifth instar larvae, respectively by Monobrullah and Nagata [13]. The treatments of early instars were more effective; this indicated that the early instars, being surface feeders, ingest more of the surface applied treatment per unit weight of feed than the older larvae [15]. The negative correlation between susceptibility of the larvae and period of development was also attributed to change in biomass with advancement of age. Thus decreased larval susceptibility was largely correlated with increase in body weight which is in corroboration with the findings of Evans [6, 7] and Teakle *et al* [18]. Ten day old larvae were found to be more resistant to NPV because the physiological changes associated with pupation may not allow infection at this late development stage or the virus did not have enough time to replicate and kill the insect, which finds support from the findings of Whitlock [20], Evans [6] and Teakle *et al* [18].

Table1: Calculated LC_{50} values of different age groups of *Helicoverpa armigera* larvae infected with *Ha*NPV.

Age of Larvae (in days)	LC50* (PIB's/ml)	95% Fiducial limit		Slope (b)	Intercept (a)
		Lower	Upper		
1	1.09×10^3a	2.71×10^3	1.53×10^3	0.952	2.1035
3	3.33×10^4b	6.41×10^3	5.67×10^4	0.631	1.516
5	2.23×10^6c	2.19×10^4	7.24×10^6	0.506	1.278
8#	1.83×10^8d	8.06×10^7	5.38×10^9	0.453	0.528
10#	1.17×10^{10}e	3.14×10^8	5.11×10^7	0.401	0.173

H* Figures followed by same alphabets are not significantly different at $P<0.05$ (t-test).
Values for 8 and 10 days old larvae were obtained by extrapolation

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Ciation of this article
Vinod Kumari. Use of nuclear polyhedrosis virus (NPV) as a microbial insecticide against a polyphagous pest, *Helicoverpa armigera* (Fab.) [Lepidoptera: Noctuidae]. Int. Arch. App. Sci. Technol; Vol 5 [3] September 2014: 36-38. http://dx.doi.org/10.15515/iaast.0976-4828.5.3.3638

