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Research Note

Efficacy of nucleopolyhedrovirus against *Spilarctia obliqua* (Walker) on mulberry

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ABSTRACT: **Pot experiments carried out to study the efficacy of nucleopolyhedrovirus against the Bihar hairy caterpillar *Spilarctia obliqua* (Walker), at Bangalore indicated that a spray of NPV @ $1x10^7$ POB ml^{-1} resulted in a larval mortality of 93.33% in third instar larvae and 87.5% in fourth instar larvae. Cent per cent larval mortality was obtained when the plants were sprayed with dichlorvos @ 2 ml l^{-1}. The leaf damage for viral treatments varied from 19.65 to 41.89 and 21.0 to 38.0 per cent for third and fourth instar larvae, respectively.**

KEY WORDS: Mulberry, *So*NPV, *Spilarctia obliqua*

Spilarctia obliqua (Walker) (Lepidoptera: Arctiidae), commonly called the Bihar hairy caterpillar or jute hairy caterpillar, is a polyphagous pest attacking a variety of plants including cultivated crops. It is known to feed on more than 126 plant species causing considerable losses in various crops (Singh and Varatharajan, 1999). However, this hairy caterpillar is attacked by a large number of natural enemies (Battu *et al.*, 1972; Premchand, 1979; Battu and Ramakrishnan, 1989). In spite of these natural enemies this pest continues to pose a major threat to the cultivation of many crops such as soybean, sunflower, jute, castor, cowpea, mulberry, etc. (Deshmukh *et al.*, 1979). The larvae congregate during the first three instars on the undersurface of the leaves and skeletonize them. Once the larvae are in the fourth instar, they defoliate the crop causing enormous damage and it is difficult to control the pest using chemical pesticides. Use of ecofriendly microbial pesticides such as baculoviruses seems to be a viable alternative to ensure that environmental safety is not compromised. Jacob and Thomas (1972) for the first time reported the occurrence of a nucleopolyhedrovirus (*So*NPV) infecting *S. obliqua* larvae collected from sweet potato fields at Vellayani. Further work on *So*NPV was carried out by several workers (Battu *et al.*, 1996; Chaudhari, 1997; Singh and Varatharajan, 2001). Genomic studies were also conducted on *So*NPV (Manickavasagam *et al.*, 1992). No attempts have been made to study the efficacy of this baculovirus in the field but for the lone reference of Arora *et al.* (1996), who conducted preliminary studies with this baculovirus in groundnut fields in Ludhiana. No attempts have been made to study the efficacy of *So*NPV against Bihar hairy caterpillar on mulberry. To fill in this lacuna, preliminary studies were

conducted at the Project Directorate of Biological Control, Banglore, on the efficacy of this baculovirus in controlling *S. obliqua* on mulberry.

Late instar larvae of *S. obliqua* collected from mulberry fields of Vijayapura (Bangalore district, Karnataka) were reared in plastic tubs (25cm height x 40cm diameter) fitted with ventilated lids on bouquets of castor (*Ricinus communis* L.) leaves at 26±2°C and RH 63±10%. The larvae that pupated in silken cocoons were separated and placed in plastic containers (21cm height x 15cm diameter) lined with tissue paper. The moths that emerged were allowed to mate in acrylic cages (28 x 28 x 30cm) containing bouquets of castor leaves for egg laying. The moths were provided with 10 per cent honey solution for feeding. The eggs, laid in groups, were detached and placed in a plastic container. Once the eggs hatched, the first instar larvae were released on castor leaves in plastic containers (21cm height x 15cm diameter). The larvae were provided fresh castor leaves daily.

Extensive field surveys were conducted for the collection of *S. obliqua* larvae in and around Bangalore on mulberry (*Morus alba* L.), field beans (*Dolichos lablab* L.), alligator weed (*Alternanthera philoxeroides* Griseb.), etc. The diseased larvae that were found in the field were collected individually in vials and examined for possible microbial pathogens in the laboratory. Virosed larvae were homogenized using sterile distilled water and the suspension filtered through a double-layered muslin cloth. The homogenate was differentially centrifuged and the virus pellet obtained was stored in a refrigerator at 4°C till further use.

Castor leaves were washed thoroughly with distilled water, air-dried, and smeared with *So*NPV @ $5x10^8$ POB ml^{-1} using the polished blunt end of a glass rod. Bouquets of these virus-contaminated leaves were placed in plastic tubs (25cm height x 40cm diameter). Sixth instar larvae of *S. obliqua* were allowed to feed on these leaves. Once the treated leaves were fully consumed by the larvae, fresh castor leaves were provided. After 6-7 days, all the dead, virosed larvae were collected and processed as mentioned earlier. The POBs were quantified by phase contrast microscopy (Nikon Eclipse E 400) using a double ruled improved Neubauer haemocytometer and the virus suspension thus standardized was stored in the refrigerator.

Mulberry plants raised in pots were sprayed with *So*NPV of different concentrations as mentioned in Table 1. Crude sugar @ 1 per cent and 0.1 per cent Triton100 were added to the virus suspension which was sprayed at 1800 h. These plants were enclosed in a nylon net cage. One hour after spraying, fifteen third instar larvae were released per plant. An insecticidal check was included in addition to the untreated control. Observations were taken 5, 7 and 10 days after treatment (DAT). Per cent leaf damage was calculated (Jensen, 1977). Each treatment was replicated four times. Adopting the same procedure, one more experiment was conducted with fourth instar larvae releasing ten larvae (instead of 15) per plant. Similar observations were taken as in the previous experiment. The data were subjected to analysis of variance and means separated using Duncan's Multiple Range Test (DMRT).

In case of third instar larvae of *S. obliqua*, a larval mortality of 93.3 per cent was recorded on 10 DAT when *So*NPV was sprayed @ $1x10^7$ POB ml^{-1}. Larval mortalities for the other two concentrations of *So*NPV ($2x10^6$ and $2x10^5$ POB ml^{-1}) were 83.1 and 82.6 per cent, respectively, which were not significantly different from each other. However, cent per cent larval mortality was obtained when the plants were sprayed with dichlorvos @ 2 ml l^{-1}. The leaf damage was 8.1 per cent on dichlorvos treated plants. The per cent leaf damage to different viral treatments ranged from 19.7 to 41.9. Maximum leaf damage of 89.2 per cent (for third instar) and 97 per cent (for fourth instar) was noticed in the control (Table 1). A similar trend was observed for fourth instar larvae of *S. obliqua*. Larval mortality ranged from 57.5 to 87.5 per cent. *So*NPV @ $1x10^7$ POB ml^{-1} recorded the highest mortality of 87.5 per cent which was superior to the other two viral treatments. The leaf damage ranged from 24.5 to 48 per cent in virus treated plants when compared to 97 per cent in control. However, insecticide treatment gave

maximum larval mortality of 92.5 per cent, followed by *So*NPV @ $1x10^7$ POB ml^{-1} (87.5 per cent). The leaf damage in insecticide treated plants was 11.2 per cent. It was also noticed that third instar larvae were more susceptible to *So*NPV than the fourth instar larvae (Table 1). Larvae of *S. obliqua* are poor feeders till they cross the third instar. Once the larvae reach fourth instar, they become highly voracious. Foliar application of the virus in the early stages of larval growth will, therefore, control the pest more effectively. However, in case the virus application is delayed and the larvae are in the penultimate or final instar, it will increase the virus yield. This will could be replaced by using this virus as a biocontrol agent under field conditions against *S. obliqua*. Because of the species-specific nature of baculoviruses, parasite and predator populations (Battu *et al.*, 1972; Premchand, 1979; Battu and Ramakrishnan, 1989) of this pest will not be adversely affected in the field. Laboratory experiments conducted to test the cross infectivity of this virus to silkworm larvae (*Bombyx mori* L.) revealed the species specificity of this virus and its inability to infect the silkworm larvae (Veenakumari, unpublished). The virus is also found to be safe to vertebrates such as garden lizard (*Calotes*

Table 1. Efficacy of *S. obliqua* NPV on third and fourth instar of Bihar hairy caterpillar

Treatments	Third instar				Fourth instar			
	Per cent larval mortality Days after treatment			Per cent leaf damage	Per cent larval mortality Days after treatment			Per cent leaf damage
	5	7	10		5	7	10	
*So*NPV @ $1x10^7$ POB ml^{-1}	56.7[b]	88.3[ba]	93.3[b]	19.7[b]	30.0[b]	65.0[b]	87.5[b]	24.5[b]
*So*NPV @ $2x10^6$ POB ml^{-1}	53.3[b]	80.0[cb]	83.1[c]	28.4[c]	27.5[b]	55.0[b]	62.5[c]	34.1[c]
*So*NPV @ $4x10^5$ POB ml^{-1}	55.0[b]	75.0[c]	82.6[c]	41.9[d]	35.0[b]	55.0[b]	57.5[c]	48.4[c]
Dichlorvos @ 2ml l^{-1}	80.0[a]	93.3[a]	100.0[a]	8.1[a]	67.5[a]	87.5[a]	92.5[a]	11.2[a]
Control	5.0[c]	10.0[d]	10.0[d]	89.2[e]	10.0[c]	12.5[c]	12.5[d]	97.0[d]

*Means followed by the same letters are not significantly different (P d" 0.05) by DMRT

serve as a reservoir of the virus in the field for controlling succeeding generations of the pest. In case the moths are formed, they will pass on the virus transovarially (Chaudhari, 1997).

Arora *et al.* (1996) reported that when *So*NPV @ 250LE ha^{-1} was used against *S. obliqua* in groundnut fields of Ludhiana, Punjab, it required a minimum of 5 days to obtain sufficient larval mortality. Based on this result and the encouraging results obtained in the present experiments, there is a good possibility that chemical insecticides

versicolor Fitzinger), common crow (*Corvus splendens* Vieillot), house sparrow (*Passer domesticus* L.), mouse (*Mus musculus* L.) and the rat (*Rattus rattus* Fischer de Waldheim) (Battu, 1987). It is further speculated that these vertebrates might help in the dissemination of this baculovirus when they feed on virosed larvae, causing epizootics in the field (Battu, 1987). Varatharajan and Singh (2002) reported that this virus can be easily and economically mass produced when the weed *Ipomoea carnea* Jacq. is used as the larval host plant to rear S. *obliqua* for the multiplication

of the virus. Alligator weed, another host plant of this pest, is very common in the lakes of Bangalore. The possibility of using this weed for the multiplication of *S. obliqua* for virus production should be worked out under local conditions. This virus can then be easily and economically mass produced under local conditions.

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REFERENCES

Arora, R., Battu, G. S., Bath, D. S. and Singh, M. 1996. Management of Bihar hairy caterpillar, *Spilosoma obliqua* (Walker) with a nuclear polyhedrosis virus. *Indian Journal of Ecology*, **23**: 138-140.

Battu, G. S. 1987. Lack of susceptibility of some vertebrate predators to five baculoviruses of the lepidopteran pests. *Journal of Entomological Research*, **11**: 184-188.

Battu, G. S. and Ramakrishnan, N. 1989. Comparative role of various mortality factors in the natural control of *Spilosoma obliqua* (Walker) in Northern India. *Journal of Entomological Research*, **13**: 38-42.

Battu, G. S., Bindra, O. S. and Rangarajan, O. M. 1972. Investigations on microbial infections of insect-pests in the Punjab. *Indian Journal of Entomology*, **33**: 317-325.

Battu, G. S., Ramakrishnan, N. and Prakash, N. 1996. Electron microscopy of the nuclear polyhedrosis virus of *Spilosoma obliqua* (Walker) alkali dissolution of occlusion bodies. *Shashpa*, **3**: 37-45.

Chaudhari, S. 1997. Effect of age of *Spilosoma obliqua* larvae on their susceptibility to nuclear polyhedrosis virus. *Indian Journal of Entomology*, **59**: 59-61.

Deshmukh, P. D., Rathor, Y. S., and Bhattacharya, A. K. 1979. Host range of Bihar hairy caterpillar *Diacrisia obliqua* Walker. *Bulletin of Entomology*, **17**: 85-99.

Jacob, A. and Thomas, M. J. 1972. A nuclear polyhedrosis virus of *Diacrisia obliqua* (Walk.). (Arctiidae, Lepidoptera). *Agricultural Research Journal of Kerala*, **12**: 82-83.

Jensen, R. L., Newsom, L. D., Herzog, D. C., Thomas, J. W., Farthing, B. R and Martin, F. A. 1977. A method of estimating insect defoliation of soybean. *Journal of Economic Entomology*, **70**: 240-242.

Manickavasagam, S., Ramakrishnan, N., Anuradha, S. and Prasad, Y.G. 1992. Identification of three nuclear polyhedrosis viruses through restriction endonuclease analysis. *Journal of Biological Control*, **6**: 101-103.

Premchand, 1979. Polyhedrosis of *Diacrisia obliqua* Walker. *Indian Journal of Entomology*, **41**: 194.

Singh, Y. R. and Varatharajan, R. 1999. Host range of Bihar hairy caterpillar, *Spilosoma obliqua* (Walker) (Arctiidae, Lepidoptera). *Hexapoda*, **11**: 65-74.

Singh, Y. R. and Varatharajan, R. 2001. Certain aspects of NPV infecting the larvae of *Spilosoma obliqua* (Walker) (Arctiidae). In: Ignacimuthu, S. and Sen, A. (Eds.). *Microbials in Insect Pest Management*. Oxford IBH Publishing Co. Pvt. Ltd.

Varatharajan, R. and Singh, M.I. 2002. *In vivo* production of *Spilarctia obliqua* (Walker) NPV. *Proceedings of the Symposium on Biological Control of Lepidopteran Pests*. July 17-18, Bangalore, India.

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