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Efficacy of Nuclear Polyhedrosis Virus against *Spilosoma obliqua* (Walker) on Cowpea

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ABSTRACT

A single application of a nuclear polyhedrosis virus (NPV) of *Spilosoma obliqua* (Walker) at 2 concentrations viz., 10^6 and 10^9 Polyhedral occlusion bodies/ml of the spray fluid was compared with two insecticides namely, endosulfan (0.07%) and diazinon (0.04%) all as high volume spray on cowpea plants under cage conditions in a pot-culture experiment against *S. obliqua*. Based on mean damaged leaves, all the four treatments were better than control in protecting the cowpea plants against *S. obliqua*. Endosulfan was the most effective insecticide followed by diazinon and the virus at both the concentrations throughout the experiment. With respect to mean number of recoverable larvae, diazinon was the least effective compared to endosulfan and virus. The virus persisted on the foliage of cowpea plants for a period of 5 days with 53.3 per cent of its original activity.

Key Words : *Spilosoma obliqua*, NPV, cowpea, persistence

The Bihar hairy-caterpillar, *Spilosoma obliqua* (Walker) is a sporadic polyphagous pest, potentially destructive to a wide variety of plant species of economic importance (Bhattacharya and Rathore, 1977; Sachan, 1981). Severe outbreaks of this insect appeared quite frequently (Deshmukh *et al.*, 1976; Grewal *et al.*, 1978) in our country. A nuclear polyhedrosis virus (NPV) reported from *S. obliqua* (Jacob and Thomas, 1972; Battu *et al.*, 1977) was observed to be an important natural mortality factor of this pest throughout Northern India (Battu, 1982). The results of a pot culture experiment on the efficacy of this virus in the control of *S. obliqua* on cowpea plants is reported in this paper.

MATERIALS AND METHODS

Seeds of cowpea, *Vigna unquiculata* (L.) Walp (a variety, 152 developed at IARI) were sown in earthen pots (30 cm dia.). The NPV of *S. obliqua* obtained from diseased larvae was partially purified by filtration and differential centrifugation. The virus was tested when the seedlings were 45 days old at 10^9 and 10^6 polyhedral occlusion bodies (POB) per ml of spray fluid and compared with endosulfan (0.07%) and diazinon (0.04%) as high volume sprays. Tween-80 was added at 0.05% concentration of the spray fluid as a wetting agent. Water containing Tween-80 (0.05%) was sprayed in the control. Twenty cowpea plants were thoroughly sprayed to the run off level using a Ganesh hand compression sprayer in the evening (4-5 pm).

The damage potential of the field-collected (6 to 8 days old) larvae of *S. obliqua* was assessed by releasing ten larvae per plant immediately after spraying. The plants along with the pots were covered with muslin cloth bags to prevent the escape of the larvae. Observation on the survival of the larvae and the number of damaged and undamaged leaves were recorded on the fourth and eighth days of the treatment. At the end of the experiment, 5 to 7 leaves were plucked randomly from each plant, and the leaf area damaged was measured by using an automatic area meter (Model AAM-7, Hayashi Denkoh Co. Ltd., Tokyo, Japan). The same samples of the leaves were dried to a constant weight in a hot air oven at 60°C for recording the dry matter. The data were transformed into arcsin values and analysed by Duncan's Multiple Range Test.

The persistence of NPV of *S. obliqua* was studied through bioassay. Five cowpea plants were sprayed with 10^9 POB/ml containing 0.05% Tween-80 as wetting agent before sunrise and the treated plants were kept in the open for five days. Six leaves were plucked at random at the rate of two leaves each from top, middle and bottom of the plant at 0, 4, 8, 12, 24, 30, 36, 48, 60, 72, 82 and 120 hours. The leaves were fed to the field- collected 6 to 8 day-old larvae of *S. obliqua* at the rate of two leaves per 10 larvae in a glass jar. There were 30 larvae for each sample interval consisting of three replicates. The larvae after consuming the treated leaves were fed with fresh castor leaves daily till their death/pupation. The mortality data

Table 1. **Comparative efficacy of nuclear polyhedrosis virus and insecticides against *Spilosoma obliqua* on cowpea**

Treatments	4th day of the treatment		8th day of the treatment		At the end of the experiment	
	Leaf damage (%)	No. of living larvae/plant	Leaf damage	No. of living larvae/plant	Leaf area damaged (%)	Dry matter of leaf (%)
NPV 10^6 POB/ml	51.73^{cd}	1.75^{b}	43.17^{bd}	0.45^{b}	10.28^{bd}	53.44^{b}
NPV 10^9 POB/ml	54.16^{d}	3.20^{b}	48.12^{d}	0.10^{ab}	14.32^{d}	52.50^{b}
Endosulfan 0.07%	15.59^{a}	0.10^{a}	11.86^{ac}	0.00^{ab}	5.38^{ac}	61.09^{a}
Diazinon 0.04%	42.89^{bc}	3.25^{b}	48.63^{d}	1.25^{c}	11.79^{d}	48.41^{b}
Control	69.26^{e}	8.10^{c}	59.09^{e}	2.10^{d}	24.08^{e}	52.10^{b}

Means followed by the same letters do not differ significantly (P=0.05) as per Duncan's Multiple Range test

recorded were used to determine the viral inactivation by solar irradiation. The LT_{50} values were calculated as per Biever and Hostetter (1971) to indicate the extent of inactivation.

RESULTS AND DICUSSION

On the 4th day of the treatment, all the treatments were equally effective in reducing the leaf damage (Table 1). Among the treatments, endosulfan gave the highest degree of protection based on the lowest percentage of damaged leaves (15.59) compared to other treatments which registered damage as high as 42.89 to 54.16 per cent. The virus at both concentrations protected the crop equally while the differences between mean per cent damaged leaves in case of low concentration of virus (10^6 POB/ml) and diazinon (0.04%) were not significant.

Considering the mean number of living larvae recorded on the 4th day of the treatment, it may be concluded that all the treatements were effective in reducing the larval population compared to untreated plants. Diazinon and the virus at both concentrations were at par in killing the larvae whereas endosulfan resulted in better larval mortality.

On the 8th day of treatment, significant effect in terms of mean percentage of damaged leaves was noticed in all treatments compared with the control. Endosulfan was the most effective treatment whereas the virus at both the concentrations and diazinon were at par in reducing the damage. Endosulfan as well as the virus at both the concentrations compared well and were equally effective in reducing the larval numbers compared to diazinon which was the least effective.

Compared to control, all the four treatments had protected the cowpea plants against *S. obliqua* based on percentage leaf damaged. Endosulfan proved superior to all the other three effective treatments. On the contrary, mean level of dry matter produced per leaf per plant indicated that significantly more dry matter production was obtained with endosulfan treatment compared to the remaining treatments. The dry matter production in the virus treatments and diazinon was not significantly superior to that of control.

Field trials with NPV of *S. obliqua* have not been conducted so far. However dosage-mortality data were obtained earlier and the calculated LD_{50} values for 4 and 8 day-old larvae weighing on an average 11.6 and 119.6 mg were respectively 741 and 13,360 POB/larva (Ramakrishnan and Chaudhari, 1979). Efficacy of other NPVs in reducing the larval population and also leaf damage has been reported in our country (Jayaraj *et al.*, 1980; Santharam *et al.*, 1981; Ramakrishnan *et al.*, 1981). Battu (1982) has reported as high as 80% natural incidence of NPV in the field population of *S. obliqua* during a survey in U.P. and Punjab. In the present investigation endosulfan proved superior because of the quick larval mortality thus preventing the damage due to the feeding of *S. obliqua* on cowpea plants.

The observations on the larval mortality resulting from feeding on leaves of cowpea plants sprayed with polyhedral suspension (10^9 POB/ml) and exposed to sunlight for various durations and the calculated LT_{50} in hours are presented in Table 2. There was no rain and the mean daily temperature and relative humidity were 24.0 to

Table 2. Persistence of nuclear polyhedrosis virus of *S. obliqua* on cowpea

Exposure period (h)	LT_{50} (h)	Final mortality (%)
Unexposed	78.3	100.0 (5)
4	83.1	100.0 (7)
8	99.0	100.0 (8)
12	128.0	100.0 (9)
24	150.0	100.0 (10)
30	168.0	100.0 (10)
36	172.0	93.3 (11)
48	172.0	86.7 (11)
60	186.0	86.7 (11)
72	192.0	83.3 (11)
84	192.0	80.0 (11)
96	200.0	73.3 (11)
120	228.0	53.3 (11)

26.5°C and 56.0 to 65.5 per cent respectively throughout the course of this experiment.

The degree of inactivation was assessed by percentage of total mortality as well as on the basis of LT_{50} values. The data revealed that there was a direct relationship between the duration of exposure to sunlight and the loss in activity of the virus. The NPV of *S. obliqua* persisted on cowpea foliage for 5 days with reduction in its activity. The concentration of virus unexposed gave cent per cent mortality within 5 days, with a LT_{50} value of 78.3 h. When the virus-sprayed pots were kept exposed to weather for 120 h, the final mortality recorded in bioassay experiment was 53.3% with a LT_{50} value of 228.0 h indicating a loss of activity. Varying levels of persistence of NPV on field crops have been reported and in some cases it has been attributed to crop canopy (Ramakrishnan *et al.*, 1981; Young and Yearian, 1974). The virus when exposed to germicidal lamp (253.7 nm) was inactivated within a few minutes (Ignoffo and Batzer, 1971; Pawar and Ramakrishnan, 1977). However, no radiation from the sun of wave length less than 291.5 nm reaches the earth surface and hence sunlight is less germicidal than short wave UV light. The NPV of *Trichoplusia ni* persisted for 2 days on cabbage (Jaques, 1972) while the NPV of *S. litura* persisted for only a day on banana (Santharam, *et al.*, 1978). In the present investigation, the NPV of *S. obliqua* persisted upto 120 h, with reduced original activity on cowpea plants. As the virus preparations were only partially purified, the retention of activity could be attributed to the accompanying impurity. Increased persistence of impure suspension of virus on foliage has been demonstrated in a number of viruses (Manjunath and Mathad, 1981, David; 1969; Jaques, 1972)

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