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Persistence of the Nuclear Polyhedrosis Virus of the Rice Swarming Caterpillar *Spodoptera Mauritia* (Boisduval) in Soil

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ABSTRACT

Persistence of the nuclear polyhedrosis virus (NPV) of *Spodoptera mauritia* (Boisduval) in soil was studied. The virus when incorporated in soil and kept under field conditions had a half life of 6.46 months, while it was 16.03 months for the virus in soil kept under laboratory conditions. A comparison of the LT_{50} values showed that the virus lost its virulence more rapidly when the virus treated soil was kept outdoors. The virus stored in a refrigerator showed only slight loss in original activity even after 18 months.

KEY WORDS: Nuclear polyhedrosis virus, *Spodoptera mauritia*, soil persistence

The rice swarming caterpillar, *Spodoptera mauritia* (Biosduval) is a serious pest of paddy. A nuclear poly-hedrosis virus infecting this insect was reported in India by Jacob *et al.* (1973). Further studies on this virus by Nair and Jacob (1982) proved its effectiveness in controlling the pest. The occlusion bodies of insect viruses are known to persist in soil for long periods without loss of infectivity. This property is of much practical significance as the soil-borne virus can initiate epizootics in subsequent seasons. The present paper deals with the persistence of the NPV of *S. mauritia* in soil.

MATERIALS AND METHODS

Soil collected from paddy fields of the College of Agriculture, Vellayani (pH 4.5, conductivity 0.26 milliomhs per cm) was used in the experiment. The soil was dried in the sun for three days, finely ground and passed through a 20 mesh sieve. The sieved soil was divided into nine lots of 1 kg each. Each lot was placed in a rectangular glass trough (20 x 20 x 10 cm). Soil in six troughs were mixed with the polyhedral suspension containing 48 x 10^6 polyhedral occlusion bodies (POB) / ml at the rate of 200 ml per trough. Soil in the remaining three troughs were mixed with 200 ml each of sterile distilled water to serve as control. Three troughs containing virus-treated soil were kept in the open field covered with a polythene film to prevent drenching in the rains. The remaining three troughs containing virus-treated soil were kept inside the laboratory covered similarly with polythene film. Moisture content of the soil in all the troughs was kept at field capacity by daily addition of required quantity of sterile distilled water.

Soil samples were drawn from the troughs at monthly intervals upto 18 months, the first sample being drawn on the first day of experiment. On each sampling occasion, 5 g soil was drawn from each trough. Each sample was then suspended in 10 ml sterile distilled water, stirred thoroughly and allowed to stand for 30 minutes to enable the heavier particles to settle. The clear supernatant was decanted, volume made upto 10 ml and used for the bioassay of viral activity against third instar larvae of *S. mauritia*. Grass terminals were dipped in this aqueous suspension containing 0.1 per cent teepol, air-dried and fed to third instar larvae of *S. mauritia* confined in specimen tubes. There were three replications with 15 larvae in each treatment. Observations were recorded daily on larval mortality, pupation and adult emergence.

A sample of the virus suspension containing 48x10^6 POB / ml kept in a refrigerator at 4°C was also bioassayed at the beginning of the experiment and thereafter at six month intervals for comparison with the viral activity of the virus-treated soil.

RESULTS AND DISCUSSION

It can be seen from Table 1 that the mortality of larvae due to virus infection declined from 82.2 per cent to 11.1 per cent in 18 months when the virus-treated soil was kept outdoors and to 40 per cent when the same was kept indoors. The virus-treated soil kept outdoors retained 50 per cent of its infectivity upto seven months while the sample kept indoors retained 50 per cent of its infectivity upto 14 months. The virus suspension kept in a refrigerator retained 82.2 per cent of the infectivity even after 10 months. The computed half life (Table 2) of the NPV in soil kept outdoors was 6.46 months while it was 16.03 months for that in soil kept indoors. The results also showed considerable prolongation of incubation period the mean time to larval death for the virus from soil kept outdoors and indoors when compared with the virus suspension kept in the refrigerator.

In a period of 7 months, the LT_{50} values increased from 4.4 days to 8.9 days for the virus from soil kept outdoors and to 7.5 days in the case of virus from the soil kept indoors. Whereas, the LT_{50} values of the virus samples kept in the refrigerator was only 5.1 days after 18 months storage.

These results demonstrate the persistence of the NPV of *S. mauritia* in soil. The remarkable stability of baculoviruses in soil has been reported by several workers (Thomas *et al.*, 1972; Thompson and Scot, 1979; Manjunath and Mathad 1981; Evans and Harrap, 1982). Strong adsorption of virus inclusion bodies to soil particles was also reported (Hukuhara and Namura 1971; Hukuhara, 1972). These studies proved the remarkable resistance of polyhedra to decomposition in a chemically and microbiologically complex environment like soil. Jaques and Huston (1959) found that polyhedral protein was highly resistant to microbial putrifaction. It is possible that the high silicon content of polyhedra (Estes and Faust, 1966) might contribute to its resistance to break down. Comparison of the LT_{50} values showed that virus-treated soil kept outdoors lost its infectivity more rapidly than the virus treated soil kept indoors. The estimated half life of the virus in soil kept outdoors was less than half of the virus in soil kept indoors. This may be expected since under field conditions, the soil is subjected to more direct action of environmental factors like sunlight. Further, soil temperature under field condition may rise to 40°C and above in summer months and exposure to such high soil temperature for prolonged periods can speed up the inactivation of the virus. Inactivation of baculoviruses was attributed to high field temperature and solar radiation particularly of UV spectrum (Gudawskas and Canerday, 1968; Ignoffo, 1968; Ignoffo and Hostetter, 1977).

It is evident from these results that NPV of *S.mauritia* can remain stable in soil without much loss of infectivity for a comparatively longer period eventhough it is exposed to the environment. A half life of 6.46 months of the NPV of *S. mauritia* in soil under open field conditions is very useful for a seasonal crop like paddy where the interval between the successive crops rarely exceeds 6 months. The virus deposited in soil from spray drift or from dead remains of infected larvae can remain in the soil and serve as a source of inoculam for initiating early epizootics in subsequent seasons. The long shelf life of the virus is also evident from the results.

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TABLE 1 : Persistence of the NPV of *S. mauritia* in soil kept indoors and outdoors in comparison with the NPV stored in a refrigerator

Period of storage (months)	Virus-treated soil kept outdoors		Virus-treated soil kept indoors		Virus stored in refrigerator	
	larval mortality (%)	Mean time for mortality (days)	larval mortality (%)	Mean time for mortality (days)	larval mortality (%)	Mean time for mortality (days)
0	82.22	4.513	82.22	4.513	86.66	4.460
1	83.71	5.052	81.39	5.270		
2	82.22	5.648	82.22	5.297		
3	71.11	5.875	80.00	5.361		
4	71.11	6.343	77.77	6.085		
5	64.44	6.586	68.88	5.581		
6	62.22	6.821	68.88	5.903	84.44	4.868
7	53.33	6.583	66.66	6.700		
8	46.66	6.857	62.22	6.607		
9	48.88	6.727	62.22	6.678		
10	44.44	6.750	60.00	7.148		
11	37.77	7.294	57.77	6.423		
12	35.55	6.937	57.77	6.654	82.22	5.027
13	24.44	7.083	53.33	7.166		
14	22.22	9.500	51.11	7.130		
15	20.00	9.777	48.88	7.136		
16	17.77	9.500	48.88	7.409		
17	13.33	9.500	46.66	7.524		
18	11.11	9.800	40.00	8.000	82.22	5.162

* Values corrected for control mortality

TABLE 2 : Half life of the NPV of *S. mauritia* in soil kept outdoors and indoors

Treatments	Regression equation	Half life (months)	Fiducial limits
NPV treated soil kept outdoors	Y = 8.3179 - 1.8330 x	6.46	5.637 7.271
NPV treated soil kept indoors	Y = 7.1563 - 0.9781 x	16.03	12.53 23.41

TABLE 3 : LT_{50} of NPV kept under different conditions to third instar larvae of *S. mauritia*

Period of storage (months)	**Virus from soil kept outdoors		*Virus from soil kept indoors		*Virus kept in refrigerator	
	Regression equation	LT_{50} (days)	Regression equation	LT_{50} (days)	Regression equation	LT_{50} (days)
0	Y = 4.3459x + 2.2080	4.389	Y = 4.3459x + 2.2080	4.389	Y = 4.5766x + 2.1732	4.146
1	Y = 4.9793x + 1.4583	5.142	Y = 5.7354x + 0.9123	5.160		
2	Y = 4.9705x + 1.3306	5.473	Y = 5.3688x + 0.9509	5.676		
3	Y = 5.3911x + 0.8075	5.992	Y = 4.8660x + 1.0645	6.437		
4	Y = 5.3607x + 0.7193	6.288	Y = 5.1200x + 0.6942	6.933		
5	Y = 4.6314x + 1.2613	6.415	Y = 4.0327x + 1.3847	7.877		
6	Y = 4.1422x + 1.5923	6.646	Y = 4.3770x + 0.9572	8.387	Y = 4.7887x + 1.785	4.691
7	Y = 5.0830x + 0.1558	7.457	Y = 3.7310x + 1.4601	8.855		
8	Y = 5.1701x + 0.1068	7.754				
9	Y = 6.1198x + 0.4883	7.854				
10	Y = 6.6173x + 0.6467	8.766				
11	Y = 4.4839x + 0.8934	8.237				
12	Y = 4.0805x + 1.1887	8.588			Y = 6.1516x + 0.7375	4.930
13	Y = 4.2593x + 0.8967	9.189				
14	Y = 4.5169x + 0.6094	9.376				
15						
16						
17						
18					Y = 5.0117x + 1.4519	5.104

* The LT_{50} was computed for 7 months only as the mortality was less than 50% afterwards
** The LT_{50} was computed for 14 months only as the mortality was less than 50% afterwards

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