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Efficacy of Nuclear Polyhedrosis Virus Formulations Against *Spodoptera litura* F. Larvae

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ABSTRACT

The nuclear polyhedrosis virus of *Spodoptera litura* F. was formulated into wettable powders and dusts and their efficacy was tested against second instar larvae of *S. litura* in the laboratory. The results showed that wettable powder formulations were as effective as the unformulated virus. Wettable powder prepared with dedenol as the wetting and dispersing agent was better than dust formulations. When water was used instead of acetone in the preparation of the formulations particularly the dusts, the efficacy was increased. The WP formulation began to loose its virulence from the third month onwards of storage.

Key Words : Nuclear polyhedrosis virus, formulations, wettable powder, dusts, *Spodoptera litura*

The tobacco cutworm *Spodoptera litura* F., a serious pest on several agricultural crops can be successfully controlled with the nuclear polyhedrosis virus (Jayaraj and Rabindra, 1989). Earlier, a few attempts were made to produce suitable formulations of the virus (Okada, 1977; Chaudhari and Ramakrishnan, 1979; Dhandapani and Kumarasami, 1982). This communication deals with evaluation of some NPV formulations against larvae of *S. litura*.

MATERIALS AND METHODS

The virus propagated in fourth instar larvae of *S. litura* was semipurified by differential centrifugation and the concentration of polyhedral occlusion bodies (POB) assessed using an improved Neubauer haemocytometer. The virus was formulated with talc, kaolin or China clay as fillers, into dusts and using certain commercial wetting and dispersing agents, wettable powder formulations were also prepared following the methods described by Ethiraju *et al.* (1988). Either distilled water or acetone was used for handling the virus pellet while preparing the formulations and the efficacy was tested in the laboratory against second instar larvae of *S. litura*.

Castor *(Ricinus communis L.)* leaf discs (7 cm dia) were washed thoroughly in water containing 0.1% Teepol and air dried. The different treatments (Table 1,2) were applied on the leaf discs using either the Potter's spray (12 cm dia) or dust towers (36.3 cm dia). The suspensions of unformulated NPV as well as wettable powder formulations were adjusted to a concentration of 2×10^6 POB/ml. After thorough mixing, one ml of the suspension was fed through the Potter's tower at a pressure of 2.5 kg/cm^2. This resulted in a deposit of Ca. 30.4 to 35.57 POB/mm^2 (Table 1). Two leaf discs were treated for each treatment. Regarding the dust formulations, a quantity of 103.32 mg in each of the formulation containing 6.2×10^6 POB was used to ensure a deposition rate equal to that of NPV spray suspension. Suitable controls were maintained. After the leaf discs treated with the suspensions had dried, they were placed inside sterile Petri plates (10 cm dia) containing moist filter paper discs. Second instar larvae of *S. litura* starved for 6 h were released on the treated leaf discs at the rate of 5 per disc. Each treatment carried 8-10 larvae and the treatments were replicated thrice. The larvae were allowed to feed for 24 h and then removed to individual vials containing a semisynthetic diet lacking formalin and plugged with sterile absorbent cotton. Mortality was recorded daily from 48h onwards.

The wettable powder formulations of *S. litura* NPV prepared using water and stored for one to six months were assayed against second instar larvae of *S. litura* as described earlier. Since the dust formulations of NPV were less effective, storage stability was studied only for the WP formulations.

RESULTS AND DISCUSSION

The laboratory tests on the virus formulations showed that the mortality rates were rather low in all the treatments including the wettable powder (edenol) formulation which gave only 62.5 percent mortality (Table 1). In this experiment, wettable powder particularly, the one with Dedenol was

Table 1. Efficacy of NPV formulations (involving acetone) against second instar larvae of *S.litura*

Treatments*		Deposition rate POB/mm^2 ($\bar{x} \pm$ SE)	Mean leaf area consumed (mm2)/larva ($\bar{x} \pm$ SE)	Mean per cent mortality ($\bar{x} \pm$ SE)
NPV	(2 x 10^6 POB)/ml	30.4 ± 0.104	252.4 ± 1.9^{ab}	54.2 ± 1.07^{a}
NPV Wettable Powder (Dedenol)	"	35.6 ± 0.155	200.0 ± 0.02^{b}	62.5 ± 0.72^{a}
NPV Wettable Powder (Lissapol)	"	31.7 ± 0.105	255.8 ± 1.16^{ab}	33.3 ± 0.81^{b}
NPV Dust (talc)	(6 x 10^7 POB/g)	30.6 ± 0.159	256.4 ± 0.17^{ab}	16.7 ± 0.27^{c}
NPV Dust (kaolin)	"	34.5 ± 0.015	291.8 ± 0.87^{a}	29.2 ± 0.88^{b}
NPV Dust (China clay)	"	26.5 ± 0.088	205.8 ± 0.069^{a}	16.7 ± 0.28^{c}
Control	"	-	294.0 ± 1.37^{a}	0.0^{d}

* In a column, means followed by similar letters are not different statistically (P=0.05) DMRT

found to cause greater mortality than dust formulations. Among the dusts, the one prepared with talc was found to be better than that prepared with China clay (Table 2). Since, there were no significant differences in the leaf area consumed (Table 1,2) we cannot attribute the lower rate of mortality in dusts due to reduced leaf consumption. The possibility of other factors influencing the mortality rates needs to be looked into. When the formulations were made with the water, the efficacy was increased only in the dust formulation and not in wettable powder formulations.

In the present investigation, the application of the aqueous suspension of NPV was more effective than the dust. This has been reported with *H. armigera* NPV formulations also (Ethiraju *et al.*, (1988). A similar observation was made by Okada (1977). Thompson and Steinhaus (1950) also reported that the aqueous suspension of the polyhedra was more effective for the control of lepidopterous larvae than the dust. Dhandapani and Kumaraswami (1982) comparing the efficacy of water dispersible powder of *S. litura* NPV with that of unformulated virus found that the formulation could produce 77.8 per cent mortality which was on par with that of unformulated virus.

Laboratory studies have shown that the addition of 1.0 per cent chickpea flour or 2.0 per cent castor leaf extract to virus suspension caused significantly greater mortality than the virus alone in water suspension (Rabindra, unpublished data). There is a need for screening more such adjuvants that can be incorporated in the formulations to improve the efficacy of the virus. The efficacy of the formulations can also be increased by increasing the virus dose.

Table 2. Evaluation of NPV formulations (involving water) against second instar larvae of *S.litura*

Treatments*		$\bar{X}$ leaf area consumed (mm2)/larva	$\bar{x}$
NPV	(2 x 10^6 POB)/ml	265.4^{ab}	71.8^{a}
NPV Wettable Powder (Dedenol)	"	217.9^{b}	68.9^{a}
NPV Wettable Powder (Lissapol)	"	217.9^{b}	62.9^{ab}
NPV Dust (talc)	(6 x 10^7 POB/g)	275.3^{ab}	53.7^{b}
NPV Dust (kaolin)	"	263.3^{ab}	46.7^{c}
NPV Dust (China clay)	"	261.7^{ab}	43.9^{d}
Control	"	287.9^{a}	0.0^{e}

* In a column, means followed by similar letters are not different statistically (P=0.05) by DMRT

Table 3. Effect of storage on the NPV wettable powder (WP) formulations (involving water) against second instar larvae of *S. litura*

Storage time in months	% reduction on mortality over zero months in				$\bar{x}$
	W.P. (Dedebik) @		W.P. (Lissapol)		
0	-	(68.9)**	-	(62.9)	-
1	0.00[a]	(78.2)	0.0[a]	(75.2)	1.9[a]
2	0.00[a]	(74.8)	8.9[a]	(57.0)	4.5[a]
3	19.1[b]	(63.3)	15.6[ab]	(53.3)	17.4[b]
4	9.4[a]	(62.2)	17.8[b]	(51.9)	13.6[ab]
5	16.8[b]	(57.0)	16.7[b]	(51.9)	16.8[b]
6	16.5[b]	(57.1)	28.9[c]	(44.4)	22.7[c]
$\bar{x}$ \$	11.6	(65.9)	14.8	(56.6)	

* In a vertical column, means followed by similar letters are not different statistically (P = 0.05) by DMRT

@ Significantly different (P = 0.05) on all days except 0 and fifth days.

\$ Difference between means significant

** Figures in parenthesis represent the percentage mortalities

The experiment on the storage stability showed that the virus began to loose its virulence from the third month of storage onwards and by six months, it had lost 22.6 per cent of its virulence (Table 3). When the two formulations were compared, it was observed that the wettable powder containing Lissapol as wetting and dispersing agent was significantly affected more by storage than that containing Dedenol. The loss of virulence in the formulations may be due to either the alkaline condition of the formulation or due to storage at room temperature. To maintain the virulence of the virus, the formulations should be near neutral in pH, as higher pH values inactivate the virus (Tanada, 1959; Falcon, 1971). The storage stability of the formulation can be improved by the addition of buffering chemicals that can keep the pH of the formulation in near neutral conditions. Storage of the formulation at 4°C - 5°C should also preserve the virulence of the virus since the NPV of *S. litura* has been found to maintain its infectivity for 3½ - 12 years when stored below 5°C (Okada, 1977; Santharam, 1986).

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