Studies on efficacy of sinpv with plant extracts in the management of *Spodoptera litura* (fabricius) on cabbage

Narasimhamurthy, G.M.[1]* and Sobita Simon[2]

Department of Plant Protection Allahabad Agricultural Institute-Deemed University, Allahabad-211007, India.

ABSTRACT

Evaluation of SlNPV at 250 LE per ha in combination with different plant extracts under field condition against *Spodoptera litura* (Fab.) on cabbage. The results indicated that highest per cent (81.66%) larval reduction was recorded in the SlNPV+NSKE-5% followed by SlNPV+neem oil-0.1% (73.33%). The other plant extracts like mustard oil-0.2%, chilli garlic extract-2.5%, Calatropis leaf extract-2% and Pongamia leaf extract-2% along with SlNPV were recorded 62.78, 60.26, 55.38 and 53.75 per cent larval reduction over control (5.53%), respectively during first spray. Least per cent larval reduction was observed in sole treatment of SlNPV with 45.60%. The same trend was observed during second spray. The addition of NSKE-5% or neem oil-0.1% with SlNPV spray solution have additive effect and also avoid deterioration of NPV in the sun light and helps in bringing more reduction in the larval population of *S.litura* immidietly after each spray.

Keywords: NSKE, Plant extracts, *Spodoptera litura*, SlNPV,

Corresponding author: simhappt@gmail.com

INTRODUCTION

Cabbage is one of the most popular winter vegetable crop grown in India. It is cultivated in around 0.245 M ha with the total production of 5.617 mt. The major cabbage producing states are Uttar Pradesh, Orissa, Bihar, Assam, West Bengal, Maharashtra and Karnataka.

The cabbage was infested by number of insect pests, among them, tobacco caterpillar, *Spodoptera litura* Fabricius (Lepidoptera: Noctuidae) is most important polyphagus pests. It is distributed throughout south eastern region in the world infesting 112 species of plants belonging to 44 families, of which 40 species are known from India (Chari and Patel, 1983). The stock of *S. litura* from Andhra Pradesh seems to have developed resistance to some of the common insecticides like Carbaryl, endosulfon and monocrotophos (Ramakrishnan *et al*., 1983). The development of resistance to the effective chemicals and less effectiveness of newer chemicals were prompted the scientific community to look alternative methods of management of insect pests. Under these circumstances utilization of natural pathogens may prove worthy for control of tobacco caterpillar. Among the various bioagents used against this pest NPV has been most extensively studied for its virulence (Fuxa and Richter, 1992), pathogenicity, mass production, safety, and field efficacy in controlling *S.litura* on cabbage, groundnut, sunflower, tobacco (Jayaraj *et al*., 1999). Due to its slow action, high level of UV inactivation as well as inactivation due to glandular secretion of leaves limit its efficacy and large scale commercial production. Moreover, the slow speed of action against target insects represents another serious disadvantage of NPVs as efficient insecticides, allowing the pests to infest the crops for considerable periods of time. Hence, knowledge of the effectiveness when combined with other adjuvants especially plant based extracts is very much needed. To increase the efficacy of NPV, certain adjuvants have been used which increase adhesiveness, wettability, stability and suspensibility and act as gustatory stimulants (Rabindra and Jayaraj, 1988 and Bijjur *et al*., 1991).

Several plant products have potent biological activities and are capable of

causing developmental abnormalities in insects. However quite a few studies on compatibility of plant products with NPV against *S.litura* have been under taken. So in present investigation different plant products were mixed with SlNPV sprays to improve virulence of virus against *S.litura* on cabbage.

MATERIALS AND METHODS

The experiment was conducted to test the performance of plant products with SlNPV in the central research field of plant protection section, Allahabad Agricultural Institute-Deemed University, Allahabad. The plot size was 3×2.4 m^2 with 60 cm and 45cm spacing. One-month-old seedlings of cabbage (variety golden acre) were transplanted in the field and crop was grown as per as recommended agronomical practices.

The investigation comprised of eight treatments *viz*., T_1: SlNPV + Neem oil-0.1% , T_2: SlNPV + Mustard oil-0.2%, T_3: SlNPV + Neem Seed Kernel Extract-5%, T_4: SlNPV + Chilli garlic extract-2.5%, T_5: SlNPV + Calatropis leaf extract -2%, T_6: SlNPV + Pongamia leaf extract-2% and T_7:Sole treatment of SlNPV and T_8: untreated check. The SlNPV @ 250 LE per hectare was taken in all the treatments, different adjuvants prepared in the laboratory at desired concentration were added to SlNPV spray suspension, Jaggery (0.5%) was used as phagostimulant and teepol (0.1%) used as surfactant. The treatments were replicated thrice in Randomized Block Design (RBD). Spraying was scheduled in two times in a growing period and spraying was done using high volume of knapsack sprayer @ the recommended dosage of 500 ml/ha containing 250 larval equivalent (LE) of NPV as active infective material (one LE = 6 x 10^9 POBs). 100 ml of NPV was diluted in 400 litres of water preferable to spray using high volume knap-sack sprayer. The first spray was 45 days after transplanting and the second spray given after a fortnight interval. Five plants were randomly selected from each plot to record the observation on larval mortality. The pre-treatment and post treatment larval counts were recorded 24 hours before and 3, 5, and 7 days after each spraying respectively.

The data regarding larval population and yield were subjected to

analysis of variance (ANOVA). Cost benefit ratio (C: B) was also assessed by dividing the net monetary return by the total additional cost due to treatments (Nagrare and More, 1998)**.**

RESULTS AND DISCUSSION

The results of present investigation revealed that all the treatments were significantly superior over control (Table.1). During first spray maximum larval mortality (81.66%) was recorded in the treatment of SlNPV + NSKE-5% followed by SlNPV + Neem oil-0.1% (73.33%) at 7 days after spraying. The next effective treatments were SlNPV + Chili garlic extract-2.5% and SlNPV + mustard oil-0.2% recorded 62.78 and 60.26 percent larval reduction and were found to be on par with each other. The treatments of Calatropis leaf extract -2% and Pongamia leaf extract – 2% were found superior over control in reducing larval population up to 55.38 and 53.75 per cent, the least larval reduction was observed in sole treatment of SlNPV (45.60%) and it was found to be on par with Calatropis leaf extract -2% and Pongamia leaf extract – 2% .

Table.1 Efficacy of SlNPV with plant extracts against *Spodoptera litura* under field condition

Treatments	*First spray*				*Second spray*			
	Pre-treatment count/plant	**Cumulative percent larval reduction over control**			**Pre-treatment count/plant**	**Cumulative percent larval reduction over control**		
		3DAS	**5DAS**	**7DAS**		**3DAS**	**5DAS**	**7DAS**
T1: SlNPV+ Neem oil (0.1%)	3.30	51.88 (46.06)	64.57 (53.55)	73.33 (58.90)	3.26	51.65 (46.94)	69.45 (56.56)	76.28 (61.22)
T2: SlNPV + Mustard oil (0.2%)	3.27	41.06 (39.82)	57.06 (49.47)	62.78 (52.44)	3.30	41.06 (39.82)	55.47 (48.24)	59.06 (49.86)
T3: SlNPV + NSKE (5%)	3.33	58.06 (49.66)	74.29 (59.63)	81.66 (64.65)	3.33	56.27 (48.61)	71.08 (57.62)	83.33 (65.90)
T4: SlNPV + Chilli garlic Extract (2.5%)	3.26	42.66 (40.74)	59.06 (49.86)	60.26 (50.92)	3.27	40.93 (39.74)	49.35 (44.61)	58.73 (50.02)
T5: SlNPV+ Calatropis Leaf Extract (2%)	3.27	43.18 (41.00)	45.58 (42.43)	55.38 (48.08)	3.23	38.26 (36.94)	45.74 (42.53)	55.47 (48.14)
T6: SlNPV + Pongamia Leaf Extract (2%)	3.13	37.97 (38.01)	49.35 (44.61)	53.75 (47.15)	3.33	34.26 (36.15)	45.58 (42.43)	49.35 (44.61)
T7: SlNPV alone	3.23	32.26 (36.26)	43.16 (41.01)	45.60 (42.40)	3.13	30.67 (33.98)	37.97 (38.01)	43.33 (41.15)
T8: Untreated Control	3.40	0.00 (2.86)	4.70 (12.46)	5.53 (13.56)	3.47	0.00 (2.86)	4.70 (12.46)	0.00 (2.86)
S Ed(±)	NA	4.02	4.17	4.30	NA	3.04	4.05	4.33
CD @ 0.5	NA	7.03	7.29	7.53	NA	5.32	7.10	7.58

* **SlNPV-** *Sodoptera litura* Nuclear Polyhedrosis Virus
* Figures in the parenthesis are transformed Arc-sine values
* SlNPV @ 250 LE/ha (1×10^8 POBs per ml)
* DAS- Days After Spraying
* NA- Not Significant

Table 2: Influence of application of SlNPV alone and in combination with Plant products on yield and cost benefit ratio

Sl. No	*Treatments*	*Yield (kg/ha)*	*Per cent Increased yield over control*	*Cost of pest Control (Rs /ha)*	*Gross return Rs /ha*	*Net return/Profit (Rs /ha)*	*CB Ratio*
T1	SlNPV+ Neem oil (0.1%)	13972	48.08	2050	83832	25172	13.27
T2	SlNPV + Mustard oil (0.2%)	13711	45.32	1950	82266	23706	13.15
T3	SlNPV + NSKE (5%)	14189	50.38	2025	85134	26449	14.08
T4	SlNPV + Chilli garlic Extract (2.5%)	13617	44.32	1825	81702	23267	13.74
T5	SlNPV+ Calatropis Leaf Extract (2%)	12801	35.67	1700	76806	18496	11.88
T6	SlNPV + Pongamia Leaf Extract (2%)	12625	34.88	1700	75750	17440	11.25
T7	SlNPV alone	11726	31.75	1700	70356	12046	8.08
T8	Untreated Control	9435	-	-	56610	-	-

Similar type of trend of results were also recorded during second spray, where highest mortality of *S.litura* recorded in NSKE-5% treatment i.e. 83.33% followed by Neem oil-0.1% (76.28%).

It is clear from the above results that among the different SlNPV and botanical combinations, SlNPV + NSKE (5%) was the best treatment in reducing larval population during spray intervals , which recorded larval reduction in the range of 58.06% to 81.66% during first spray, 56.27 to 83.33% during second spray . NSKE being antifeedant enforced the larvae for repeated nibbling of foliage in search of palatable food there by increasing the ingestion of virus and also might have played as stressor which might have resulted increased susceptibility of larvae to the virus. The present findings were in accordance with findings of **Patil (1993), Sarode *et al*. (1995); Gopali (1998) and Patil (2000).**

SlNPV + Neem oil (0.1%) and SlNPV + chilli garlic extract (2.5%) were the next best treatments which recorded significantly higher percent larval reduction over sole treatment of SlNPV. The improved efficacy of NPV with neem oil was in conformity with **Muthiah (1988); Sireesha and Kulkarni (2001), Shapiro *et al* (2009).**

Even though Mustard oil, *Calatropis* leaf extract and *Pongamia* leaf extract performed remarkably well during different spray intervals, their efficacy was on par with sole treatment of SlNPV. Results of study are in line with **Sireesha and Kulkarni (2001). Patil (2000)** reported that *Pongamia* leaf extract failed to increase the efficacy of SlNPV in ground nut ecosystem

Cost Economics

The net return was highest in SlNPV + NSKE- 5% (Rs 26,449/ha) and it was followed by T1 and T2 with net returns of Rs 25,172 and 23,706, respectively. In these treatments IB: C ratio was 13.27 and 13.15, respectively (Table-2), for every one rupee invested for management of *Spodoptera litura*. Highest incremental benefit: cost ratio of 14.08 was recorded in case of SlNPV + NSKE- 5%, the least cost benefit ratio (8.08) was recorded in case of T_7: SlNPV alone. Even though same cost of control is involved in T5, T6 and T7, the benefit: cost ratio of T_5 and T_6 was higher than T_7 Therefore, the cost is an important factor in the choice of treatment.

REFERENCES

Bijjur, S., Kulkarni, K. A. and Lingappa, S. (1991). Evaluation of nuclear polyhedrosis virus with certain adjuvants for control of *Heliothis armigera* (Hub.) *Indian. J. entomol.* 53: 479-483.

Chari, M.S. and Patel, N.G. (1983). Cotton leaf worm *Spodoptera litura* (Fab.) Its biology and integrated control measures. *Cotton Development* 13: 465-482.

Deotale, R.O., Undirwade, U.B., Dawane, P.N. and Biswane, K.D. (2003). Performance of effectiveness of UV protectant against *Helicoverpa armigera* on Chick pea. *J. Soils and Crops.* 13(2): 146-148.

Fuxa, J.R. and Richter, A.R. (1992). Virulence and multiplication passage of a NPV selected for an increased rate of vertical transmission. Biological control, Department of Entomology, Agriculture Experimental station, Lousiana, U.S.A., 2(3): 171-175. (Abstract, R.A.E., 81(6): 55-84).

Gopali, J. B. (1998). Integrated management of pigeon pea pod borer *Helicoverpa armigera* (Hubner) with special reference of HaNPV and insectivorous birds. *Ph.D. thesis,* University of Agricultural Sciences, Dharwad.

Jayaraj, S.R., Rabindra, R. J. and Narayana, K. (1999). Development and use of microbial agent for the control of *Heliothis spp*. in India. In: *proceeding of Workshop on Biological Control of Heliothis: Increasing the Effectiveness of Natural Enemies.* IOBC, *Heliothis* workshop held in Nov. 1995, New Delhi pp: 483-504.

Muthiah, C. (1988). Studies on the nuclear polyhedoris virus of *Heliothis armigera* (Hub.) and its formulations. *M.Sc. (Agri) Thesis,* Tamil Nadu Agricultural University, Coimbatore.

Nagrare, V. S. and More, G. D. 1998. Economics in using bioagents against *Helicoverpa armigera* on pigeon pea. *Indian Journal of Entomology*, 60 (2): 203-206.

Patil, V.C. (1993). Integration of NPV and neem in the management of *Helicoverpa armigera* (Hubner). *M.Sc (Agri) Thesis,* University of Agricultural Sciences, Dharwad.

Patil, R.K. (2000). Ecofriendly approaches for the management of *Spodoptera litura* (F.) in groundnut. *Ph.D. Thesis,* University of Agricultural Sciences, Dharwad.

Rabindra, R.J. AND Jayaraj, S. (1988). Evaluation of certain adjuvants for NPV of the *Heliothis armigera* (Hub.) on chickpea. *Indian. J. Exptl. Bio.,* 26: 60-62.

Ramakrishnan, N., Saxena,V.S., and Dhingra, S. (1983). Insecticide resistance in the population of *Spodoptera litura* (Fab.) in Andhra Pradesh. *Pesticides* 18: 23-27.

Sarode, S.V., Patil, P.P. and Borkar, S.K. (1995). Evaluation of neem seed kernel extract in combination with *Heliothis* nuclear polyhedrosis virus against cotton boll worms. *J. Entomol. Res.* 19: 219-222.

Shapiro, M., Said El Salamouny and Shepard B.M., (2009). Plant Extracts as Ultraviolet Radiation Protectants for the Beet Armyworm (Lepidoptera: Noctuidae) Nucleopolyhedrovirus: Screening of Extracts. *J. Agric. Urban Entomol.* 26(2): 47–61.

Sireesha, K. and Kulkarni, K.A. (2001). Evaluation of different formulations of nuclear polyhedrosis virus against *Helicoverpa armigera* (Hubner). *Pest Management and Economic Zoology*, 9: 1- 4.