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

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Abstract : Results on evaluation of SLNPV at 250 LE per ha in combination with different plant extracts under field condition against *Spodoptera litura* (Fab.) on cabbage 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 botanicals like mustard oil-0.2%, chilli garlic extract-2.5%, Calatropis leaf extract-2% and Pongamia leaf extract-2% along with SLNPV recorded 62.78, 60.26, 55.38 and 53.75 per cent larval reduction, respectively over control (5.53%), after first spray. Least per cent larval reduction was observed in sole treatment of SLNPV with 45.60%. The same trend was observed after second spray. The addition of NSKE-5% or neem oil-0.1% with SLNPV spray solution showed additive effect and also avoided deterioration of NPV in the sun light and helps in bringing more reduction in the larval population of *S.litura* immidietly after each spray.

Key words: NSKE, Plant extracts, *Spodoptera litura*, SLNPV

Introduction

Among different insect pests infesting cabbage, tobacco caterpillar, *Spodoptera litura* Fabricius is most important polyphagus pests distributed throughout south eastern region in the world (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 prompted the scientific community to look for alternative methods of management of insect pests. Under these circumstances utilization of natural pathogens may prove worthy for control of tobacco caterpillar. Among 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). However, 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 recommended agronomical practices were followed.

The investigation comprised of eight treatments *viz*., T_1: SLNPV + Neem oil-0.1%, T_2: SLNPV + Mustard

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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 (one LE = 6 x 10^9 POBs). The first spray was given 45 days after transplanting and the second spray 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. Cost benefit ratio (CBR) was also worked out as per the method described by (B) Nagrare and More, 1998.

Results and Discussion

All the treatments were significantly superior over control (Table.1). The 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 first 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 on par to that of Calatropis leaf extract -2% and Pongamia leaf extract – 2% .

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%).

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% after first spray, 56.27 to 83.33% after second spray . NSKE being antifeedant enforced the larvae for repeated

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

Treatments	First spray				Second spray			
	Pre-treatment count/plant	Cumulative per cent larval reduction over control			Pre-treatment count/plant	Cumulative per cent 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	-	-

nibbling of foliage in search of palatable food there by increasing the ingestion of virus, 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 per cent 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

Economics of the treatment

The net return was highest in SLNPV + NSKE- 5% (Rs 26,449/ha). I 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*. The 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 T5 and T6 was higher than T7 Therefore, the cost is an important factor in the choice of treatment.

सारांश

गोभी पर स्पोडोप्टेरा लिटुरा के खिलाफ क्षेत्र के शर्त के तहत विभिन्न संयंत्र के अर्क के साथ संयोजन में प्रति हेक्टेयर 250 ले में एसआईएनपीवी के मूल्यांकन पर परिणाम संकेत दिया है कि उच्चतम फीसदी (81.66%) लार्वा कमी एसआईएनपीवी में दर्ज किया गया। अतः पश्चात एनएसकेई 5% + नीम तेल 0.1% में एसआईएनपीवी 73% दर्ज किया गया। एसआईएनपीवी के साथ अन्य वनस्पतिक सरसों का तेल 0.2%, मिर्च + लहसुन निकालने 2.5%, कैलाट्रापिक्स की पत्ती 2% और पौनगोभिया की पत्ती–2% के द्वारा 62.78%, 55.38%, 60.26% और 53.75 फीसदी लार्वा की कमी एसआईएनपीवी में दर्ज की गई, पहले स्प्रे के बाद प्रतिशत लार्वा कमी के प्रति कम से कम एसआईएनपीवी के एकमात्र उपचार में 45.60% के साथ मनाया एवं इसके अलावा एनएसकेई 5% या एसआईएनपीवी स्प्रे समाधान के साथ नीम के तेल (0.1%) प्रभाव दिखाया और सूरज की रोशनी में भी एनपीवी की गिरावट से बचा है और प्रत्येक स्प्रे के बाद तुरन्त ही एस लिटुरा के लार्वा के आबादी में अधिक कमी लाने में मदद करता है।

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