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Effect of *Bacillus thuringiensis* var. *kurstaki* and neem on castor defoliators - *Achaea janata* (Linnaeus) and *Spodoptera litura* (Fabricius)

P. S. VIMALA DEVI, Y. G. PRASAD and B. RAJESWARI
Directorate of Oilseeds Research, Rajendranagar, Hyderabad 500 030, India

ABSTRACT : *Bacillus thuringiensis* var. *kurstaki* was as effective as monocrotophos (0.05 %) in causing feeding cessation and mortality of *Achaea janata* (Linnaeus) on castor. However, it was ineffective against *Spodoptera litura* (Fabricius) larvae. Neem seed kernel extract (2%) resulted in ovipositional deterrence to *S. litura*.

KEY WORDS : *Achaea janata*, *Bacillus thuringiensis*, castor, neem, *Spodoptera litura*

Castor (*Ricinus communis* Linn.) is an important non-edible oilseed crop grown in several states of India. The crop is predominantly grown under rainfed conditions. The crop suffers from serious insect pests of which castor semilooper, *Achaea janata* (Linnaeus) occurs regularly in all the castor growing areas causing extensive defoliation (Chellaiah and Gopalan, 1967) and also feeds on tender shoots and developing capsules leading to considerable reduction in yields (Parthasarathy and Rao, 1989). First incidence of semilooper on annual castor occurs in late June and early July (Khan, 1946) and if left unchecked, leads to extensive defoliation as the larvae are voracious feeders. Incidence of *S. litura* begins on 6-8 weeks old crop with potential for rapid increase in population. Since *Spodoptera litura* (Fabricius) occurs at a time when the activity of natural parasitoids of semilooper namely, *Microplitis maculipennis* (Szep.) and *Euplectrus* sp. gain momentum, timing of synthetic insecticides plays a crucial role in the control of these two pests on castor. *Bacillus thuringiensis* has been in use as a safe stomach poison inducing immediate cessation of feeding for the control of many lepidopteran pests. Neem is known to act as an antifeedant and ovipositional deterrent for *S. litura* (Ayyangar and Rao, 1989).

In this paper the results on the field efficacy of *B. t.* against castor semilooper and the ovipositional deterrent effect of neem seed kernel extract on *S. litura* are reported.

MATERIALS AND METHODS

Castor (cv. GCH-4) was sown on 30 June 1995 at the Narkhoda farm of Directorate of Oilseed Research at 60 x 30 cm spacing and raised as per the recommended agronomic practices. A field experiment with 4 treatments (Table 1) was laid out in a randomised block design with 8 replications for each treatment. The plot size was 6 x 5 m. Monocrotophos spray was taken up only once while NSKE spray was imposed 2 days after *B.t.* spray. The *B.t.* preparation of var. *kurstaki* (Serotype H-3a, 3b; 3000 IU/mg, 9.0 x 10^9 viable spores/g, 5-8% endotoxin) used was a water dispersible powder supplied by M/S Biotech International, New Delhi. Aqueous extracts of shade-dried and powdered neem seed kernels were prepared by soaking over night in distilled water in the ratio of 1:20 (w/v) for kernel powder and water. The residues were hand pressed while filtering through a double layered muslin cloth for complete extraction. The volume of the filtrate was adjusted to 100 ml to get 2 per cent and 5 per cent extracts.

Semilooper population was recorded on 6 plants / replicate (one tagged plant in each of the 6 inner rows) at each observation. Whole plot counts of *S. litura* egg masses / hatched masses were taken before *B.t.* spray and 3 days after NSKE spray. Leaf samples with hatched masses from the treated and untreated plots were collected three days after NSKE spray (5 days after *B.t.* spray) and the larvae were maintained on fresh castor leaves from the second day for 10 days to record mortality. Foliar damage was rated visually as per cent leaf area consumed / plant.

Data on per cent decrease in larval population and seed yield were subjected to analysis of variance (ANOVA). Larval counts before spray and foliar damage have been presented as mean ± SD. Data on egg masses / hatched masses were subjected to Student's t-test for paired samples.

RESULTS AND DISCUSSION

Decrease in larval population 2 days after spray was highest in monocrotophos sprayed plots followed by *B. thuringiensis* (*B.t.*) 0.5 per cent + NSKE 5 per cent sprayed plots. Although, per cent decrease in larval counts of semilooper 2 days after spray was less in *B.t.* + NSKE sprayed plots when compared to the insecticidal check, an immediate feeding cessation was observed in these plots. Significant decrease in semilooper population was observed in all the treatments 5 days after spray compared to unsprayed control. The yield was highest in *B.t.* (0.5%) and NSKE (5 %) sequentially sprayed plots followed by monocrotophos sprayed plots (Table 1). Kulshrestha *et al.* (1965) reported 79.9 per cent field mortality of late instar *A. janata* larvae due to dusting of *B. t.* spores.

Table 1. Efficacy of B.t. and NSKE spray on castor semilooper

Treatment / Concentration	Larvae / plant	Foliar damage (%) after spray	Decrease in larval population (%) after spray		Primary spike seed yield
	Before spray	5 days	2 days	5 days	(kg/ha)
B.t. spray 0.5% +NSKE 5%	4.4 ± 1.69	13.1 ± 9.04	52.55 [a] (46.46)	99.36 (85.41)	366.53
B.t. spray 0.25% +NSKE 2%	1.7 ± 0.82	5.5 ± 1.77	45.50 (42.44)	99.58 (86.31)	296.00
Monocrotophos 0.05%	3.4 ± 1.69	6.2 ± 2.31	85.30 (67.42)	97.90 (81.65)	307.67
Unsprayed control	4.3 ± 1.32	52.5 ± 13.89	22.80 (28.54)	54.10 (47.35)	200.80
SEM ±			6.63	5.39	29.05
C D			26.54**	21.59**	89.51*

[a] Figures in parentheses are angular transformed values
* Significant at 5% level
** Significant at 1% level

Egg masses and hatched masses of *S. litura* were also observed in the experimental plots at the time of imposing the *B.t.* treatments. Even two days after *B. t.* spray, no mortality of *S. litura* larvae was observed. Hence, NSKE sprays were taken up against *S. litura*. Three days after NSKE sprays there was no increase in number of egg masses / hatched masses in the NSKE 2 per cent sprayed plots whereas a significant increase was recorded in the monocrotophos and unsprayed plots indicating fresh oviposition in these plots (Table 2).

Defoliation during the first 60 days of crop growth is likely to influence seed yield from the first picking (primary spike). Seed yield from the primary spike was significantly high in both *B.t.* and NSKE sequentially sprayed and insecticide sprayed plots which exhibited less foliar damage when compared to the unsprayed plots (Table 1). Deshmukh and Deshpande (1989) reported comparable yield increase at first picking due to *B.t.* spray and insecticide spray (endosulfan 0.07 %) over unsprayed control.

Table 2. Effect of neem seed kernel extract spray on oviposition by *S. litura* moths

Treatment	Mean egg/hatched masses[a]		Calculated 't' value
	before spray	3 days after spray	
NSKE spray (2%)	1.63	1.25	1.426
NSKE spray (5%)	0.88	1.25	2.049
Monocrotophos (0.05%)	0.75	2.63	15.000
Unsprayed control	0.88	1.75	3.862

Tabulated 't' value at 5% = 2.365; at 1% = 3.499

[a] Hatched masses are gregarious instar I & II

Counts in monocrotophos treatment are 5 days after spray

Our studies show that *B.t.* is as effective as monocrotophos in terms of controlling foliar damage and causing reduction in semilooper population. However, *B.t.* var. *kurstaki* strain used in this study (4.5 x 10^8 viable spores/ml at 0.5 % and 2.25 x 10^8 at 0.25 % concentration) was ineffective against *S. litura* larvae. Gaffar and Kushwaha (1994) reported that a local field isolate of *B. t.* sprayed at 4.4 x 10^8 and 2.2 x 10^8 viable spores/ml against *S. litura* on cauliflower resulted in 58.3 and 38.2 per cent mortality, respectively. In our study, NSKE both at 2 per cent and 5 per cent resulted in lower oviposition by *S. litura* compared to insecticidal check and unsprayed control. Similar ovipositional deterrent effect on *S. litura* moths due to 2 per cent NSKE spray on tobacco was reported by Joshi and Sitaramaiah (1979).

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