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Toxicity of some insecticides against seven day old larvae of Bihar hairy caterpillar, *Spilarctia obliqua* Walker

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Abstract: The stomach toxicity of some insecticides viz., Cypermethrin, Lambda cyhalothrin and Chlorpyriphos were determined against 7d old larvae of *Spilarctia obliqua* by leaf dip method. Cypermethrin was found to be the most toxic insecticide during observation at 18, 24, 48 and 72 HAF. On the basis of LC_{50} values at different time intervals the order of toxicity was, Cypermethrin > Lambda cyhalothrin > Chlorpyriphos and the LC_{50} (%) values being 0.003, 0.054, 0.107 at 24 HAF, 0.002, 0.045 and 0.101 at 48 HAF, 0.016, 0.039 and 0.085 at 72 HAF respectively. A comparative dose mortality (50%) response expressed in terms of relative toxicity indicated that RT values for Cypermethrin, Lambda cyhalothrin, and Chlorpyriphos were 35.66, 1.98 and 1.00 at 24HAF, 50.5, 2.24 and 1.00 at 48 HAF, 5.31, 2.17 and 1.00 at 72 HAF. Chlorpyriphos in particular, showed very low RT value indicating far less stomach toxicity to *S. obliqua* as compared to Cypermethrin and Lambda-cyhalothrin. These findings can be helpful for the selection of suitable insecticides for effective pest management under field condition.

Keywords: Insecticides, LC_{50}, RT, *S. obliqua*, toxicity

INTRODUCTION

The Bihar hairy caterpillar, *Spilosoma (=Diacrisia) obliqua* (Walker) (Arctiidae: Lepidoptera), is an intermittent pest widely distributed in India, China, Bangladesh, Myanmar, Nepal and Pakistan (CPC, 2004). It is a serious pest in Bihar, Madhya Pradesh, Uttar Pradesh, Punjab, Manipur and other states. Due to its highly polyphagous nature, it attacks soybean, pulses, oilseeds, cereals, certain vegetables, mulberry, medicinal, aromatic and other economic plants and causes severe economic damage (Gupta and Bhattacharya, 2008). The larvae feed gregariously and voraciously on a variety of crops. Having destroyed one field, they move in swarms to another field. As the pest passes the first generation mostly on weeds, it should be destroyed in the weed itself before the pest multiplies and migrates to the cultivated crops (Yadav *et al.,* 2001). Use of chemicals for pest control indeed has been proved as boon for agriculture and chemical insecticides are often recommended to combat the infestation of these pests (Murugesan and Dhingra, 1995). Various insecticides belonging to different classes are being used for management of this pest all over the world. These insecticides are widely reported as good lepidoptericides but continuous and indiscriminate use of insecticides by the farmers result in the development of resistance. We cannot denie the possiblility for development of resistance. To overcome this problem insecticide resistance must be continuously monitored and an integral part of chemical control should be form to enable the detection of resistance and to take necessary measures against it (Verma and Singh, 2000). Baseline data on the susceptibility of the target insect pest to the insecticide is the most important factor for monitoring the development of resistance. By keeping these points in mind, the present study was conducted to determine the toxicity (LC_{50}) of some insecticides against the larvae of *S. obliqua* by leaf-dip methods of application. The obtained LC_{50} values would serve as for the selection of insecticide for further use in field study and this base line data could be used as critical inputs in the deployment of new insecticides and insecticide resistance management programmes (Kaur and Kang, 2014).

MATERIALS AND METHODS

Lab experiment was carried out during 2012 in the IPM laboratory, Department of Entomology, College of Agriculture G.B.P.U.A&T, Pantnagar. The study was carried out to reveal the toxicity of some insecticides; Cypermethrin 25 EC, Lambda cyhalothrin 4.9 CS and Chlorpyriphos 25 EC through Pre and final experiment by using leaf dip method. During the Pre-experiment following concentrations were taken against the seven day old larvae of *S. obliqua* viz.; Cypermethrin 25 EC (0.003, 0.002, 0.001, 0.0007, 0.0005, 0.0003, and 0.0001), Lambda cyhalothrin 4.9 CS (0.05, 0.04, 0.03, 0.02, 0.01, 0.005, 0.002 %) and Chlorpyriphos 25 EC (0.04, 0.03, 0.02, 0.01, 0.005,

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0.002 and 0.001), on the basis of pre-experimental observation and literature, concentrations of mentioned insecticides were decided for the final experiment viz.; Cypermethrin 25 EC (0.006, 0.004, 0.003, 0.002 and 0.001%), Lambda cyhalothrin 4.9 CS (0.07, 0.06, 0.05, 0.04 and 0.03) and Chlorpyriphos 25 EC (0.1, 0.09, 0.08, 0.07 and 0.06%) against 7d old larvae of *S. obliqua* under laboratory conditions (28±5° Temperature and R.H. 65±5%). Leaf dip method will be followed according to (Kodandaram and Dhingra, 2007). The full grown matured Castor (*Ricinus communis*) leaves was plucked and brought to the laboratory. After proper washing, leaves were dipped in the required concentration of insecticide for one minute. Excess liquid were shaken from the foliage. This was then allowed to dry at room temperature. The treated leaves were transferred to clean plastic boxes (size 22 x 14 x 8cm). In each box, ten larvae were placed and each treatment was replicated three times. In control, the leaves were dipped in distilled water. The observations were recorded on mortality at 18, 24, 48 and 72h after feeding. Moribund larvae will be counted as dead. The average per cent mortality in each treatment was corrected by Abbott's formula (Abbott, 1925). The data so obtained was subjected to probit analysis for calculating regression equation and LC value following Finney (1971) based computer programme STPR718 at the Computer Center, College of Basic Science and Humanities of this University. The relative toxicity (RT) of insecticides was calculated based on LC 30, 50 and 90 values by using the following formula (Ramangauda and Srivastava, 2009).

$$\text{Abbott corrected mortality (\%)} = \frac{T-C}{100-C} \times 100$$

Where T= Mortality per cent in treatment
C= Mortality per cent in control

$$\textbf{RT value} = \frac{\text{LC value of leas toxic insecticide}}{\text{LC value of candidate insecticide}}$$

RESULTS AND DISCUSSION

A study was conducted to find the efficacy of Cypermethrin (0.006, 0.004, 0.003, 0.002 and 0.001%), Lambda cyhalothrin (0.07, 0.06, 0.05, 0.04 and 0.03) and Chlorpyriphos EC (0.1, 0.09, 0.08, 0.07 and 0.06%) against seven day old larvae of *S. obliqua*. Abbott's percent corrected mortality data was observed at 18, 24, 48 and 72 HAF (Hours after feeding). On the basis of observation it was found that all the three insecticides toxicity was increased as per the increased concentrations of insecticides (Table 1). The order of mortality for the different concentrations of Cypermethrin, Lambda cyhalothrin and Chlorpyriphos at 18 DAF was (6.66<10.00<16.66<20.00<26.66), (10.00<20.00<40.00<46.66<53.33) and (6.66<10.00< 16.66<23.33<36.66); at 24 HAF (23.33<30.00<36.66 <50.00<66.66), (20.00<33.33<40.00<50.00<73.33); (10.00<16.66<23.33<30.00<46.66); at 48 HAF (30.00<33.33<46.66<66.66<76.66) (26.66<43.33 <56.66 < 63.33<80.00) and (16.66<20.00<26.66 <33.33<53.33) while at 72 DAF order was (36.66 <53.33 <66.6 <80.00 <86.66), (33.33<53.33< 63.33<73.33<83.33) and (26.66 <33.33<53.33<60.00 <66.66) respectively. When the LC values were observed for Cypermethrin, Lambda cyhalothrin and Chlorpyriphos (Table 2,3 and 4) then the LC_{30}(%) values being 0.001, 0.038, 0.088 at 24 HAF, 0.001, 0.032, 0.084 at 48 HAF and 0.008,0.028,0.070 at 72 HAF likewise LC_{50}(%) values were 0.003, 0.054, 0.107 at 24 HAF, 0.002, 0.045, 0.101 at 48 HAF, 0.016, 0.039, 0.085 at 72 HAF while the LC_{90} (%) values being 0.028, 0.122, 0.169 at 24 HAF, 0.014, 0.103, 0.161 at 48 HAF, 0.007, 0.088, 0.136 at 72 HAF respectively. (RT) values for 50% mortality indicated that Cypermethrin, Lambda cyhalothrin, and Chlorpyriphos were 33.66, 1.98 and 1.00 at 24 HAF 50.5, 2.24 and 1.00 at 48 HAF 5.31, 2.17 and 1.00 at 72 HAF. Cypermethrin in particular, showed very high RT value indicating highest stomach toxicity against *S.obliqua* as compared to Chlorpyriphos and Lambda cyhalothrin. Abbott's percent corrected mortality revealed that the 50 % mortality was observed in case of Cypermethrin and Lambda-cyhalothrin at 24 HAF for the 0.004% and 0.06% concentration respectively while Chlorpyriphos showed 50 % mortality (0.1% concentration) at 18 HAF, Cypermethrin concentration (0.004%) was found to be minimum in comparison to Lambda-cyhalothrin and Chlorpyriphos concentration (0.06,0.1% respectively). Therefore on the basis of above observation and LC_{50} values order of toxicity was Cypermethrin > Lambda cyhalothrin > Chlorpyriphos. So, we can say that Cypermethrin proved to be most lethal against *S. obliqua*. The results of the present investigation substantially supported by findings of various authors as (Singh and Singh, 2000). Bioassay studies were carried out in the laboratory to determine the relative toxicity of synthetic pyrethroids, based on the LC_{50} value of different insecticides the order of toxicity was: decamethrin > cypermethrin > lambdacyhalothrin > bifenthrin > chlorpyriphos > lindane > malathion. Among all the treatments pyrethroids showed better results than other insecticides. Goel and Kumar (1991) were made field studies to control S. obliqua and Acherontia styx on sesamum using synthetic pyrethroids, viz., cypermethrin, deltamethrin, fenpropathrin, fenvalerate and fluvalinate and compared with quinalphos. Deltamethrin was found to be the most potent insecticide followed by cypermethrin against both the insect species, and were effective for 15 days of spray. (Nagia *et al*., 1990 and Muthusamy *et al*., 2011) reported that Cypermethrin was most toxic chemical among all tested insecticides against *S. obliqua*. Gupta and Yadav (2011) evaluated that the relative contact toxicity of 17 conventional and new insecticides against *S. obliqua* larva. They re-

Table 1. Toxicity of insecticides against seven day old larvae of *S. obliqua* .

Treatment	Concentration (%)	Abbott's percent corrected mortality			
		18HAF	24HAF	48HAF	72HAF
Cypermethrin 25EC	0.006	26.66	66.66	76.66	86.66
	0.004	20.00	50.00	66.66	80.00
	0.003	16.66	36.66	46.66	66.66
	0.002	10.00	30.00	33.33	53.33
	0.001	6.66	23.33	30.00	36.66
Lambda cyhalothrin 4.9 CS	0.07	53.33	73.33	80.00	83.33
	0.06	46.66	50.00	63.33	73.33
	0.05	40.00	40.00	56.66	63.33
	0.04	20.00	33.33	43.33	53.33
	0.03	10.00	20.00	26.66	33.33
Chlorpyriphos 25EC	0.1	50.00	66.66	73.33	90.00
	0.09	36.66	53.33	66.66	86.66
	0.08	23.33	33.33	60.00	66.66
	0.07	16.66	20.00	43.33	56.66
	0.06	10.00	16.66	33.33	36.66

Table 2. Dosage mortality responses of seven day old larvae of *S. obliqua* (Walker) against Cypermethrin by leaf dip method at 24 hours after feeding.

Insecticides	LC_{30} (%)	Relative toxicity	LC_{50} (%)	Relative toxicity	LC_{90} (%)	Relative toxicity	Chi square	Regression equation Y=a+bx	Fiducial limit at LC_{50}	
									Lower	Upper
Cypermethrin 25 EC	0.001	88	0.003	35.66	0.028	6.03	1.504	y=4.304+0.356x	0.002	0.007
Lambda cy-halothrin 4.9 CS	0.038	2.31	0.054	1.98	0.122	1.38	1.752	y=4.268+0.342x	0.047	0.065
Chlorpyriphos 25 EC	0.088	1	0.107	1	0.169	1	3.206	y=4.348+0.37x	0.095	0.176

Table 3. Dosage mortality responses of seven day old larvae of *S. obliqua* against Cypermethrin by leaf dip method at 48 hours after feeding.

Insecticides	LC_{30} (%)	Relative toxicity	LC_{50} (%)	Relative toxicity	LC_{90} (%)	Relative toxicity	Chi square	Regression equation Y=a+bx	Fiducial limit at LC50	
									Lower	Upper
Cypermethrin 25 EC	0.001	84	0.002	50.5	0.014	11.5	2.698	y =4.074+0.344x	0.001	0.003
Lambda cy-halothrin 4.9 CS	0.032	2.62	0.045	2.24	0.103	1.56	0.971	y =4.042+0.344x	0.038	0.052
Chlorpyriphos 25 EC	0.084	1	0.101	1	0.161	1	2.218	y = 4.323+0.271x	0.092	0.142

ported the descending order of relative toxicity for 3-4-day-old larvae was: Lambda-cyhalothrin > deltamethrin > alphamethrin> chlorpyriphos > cypermethrin > fenvalerate > quinalphos > Prokill > prophenophos >dichlorvos > monocrotophos > methomyl > triazophos > phenthoate > endosulphan > C-505 > dimethoate. (Mandal, *et al.*, 2013) conducted a field experiment for the management of Bihar hairy caterpillar (*S. obliqua* Walk.) in black gram by using different insecticides. The order of efficacy: triazophos (90.64%)>ë-cyhalothrin(83.71%) >indoxacarb (78.76%) > endosulfan (69.53%) >imidacloprid (62.31%) > thiamethoxam (57.40%).

Conclusion

Overall results provided the LC_{50} and RT values which shows the concentration required to kill 50% insects and relative toxicity of insecticides respectively, as the Cypermethrin showed minimum $LC_{50,}$ less time provided and maximum RT values followed by Lambda-cyhalothrin and Chlorpyriphos, though we can conclude that Cypermethrin proved to be most lethal insecticide as compard to other three insecticides and can be a good control measure for the management of *S. obliqua*. The study would also be helpful to develop management strategies to overcome the resistance problems and to manage *S. obliqua* under field conditions in the future.

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Table 4. Dosage mortality responses of seven day old larvae of *S. obliqua* against Cypermethrin by leaf dip method at 72 hours

Insecticides	LC_{30} (%)	Relative toxicity	LC_{50} (%)	Relative toxicity	LC_{90} (%)	Relative toxicity	Chi square	Regression equation Y=a+bx	Fiducial limit at LC50	
									Lower	Upper
Cypermethrin 25 EC	0.008	8.75	0.016	5.31	0.007	19.4	0.439	y =4.348+0.37x	0.001	0.002
Lambda cy-halothrin 4.9 CS	0.028	2.5	0.039	2.17	0.088	1.54	0.091	y =3.8+0.338x	0.032	0.045
Chlorpyriphos 25 EC	0.070	1	0.085	1	0.136	1	5.005	y =3.527+0.373x	0.077	0.095

providing the necessary facilities and support.

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