Indian Journal of Applied Entomology **24**(1) : 16-19 (2010)

SAFETY INDEX OF SOME INSECTICIDES AND BIOPESTICIDES AGAINST EGG PARASITOID, *TRICHOGRAMMA BRASILIENSIS* ASHMEAD

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ABSTRACT

Twenty freshly emerged (24hours old) adult parasitoid *Trichogramma brasiliensis* were released in glass vials coated with thin film of different concentrations of insecticides. Observations on the mortality of the adults were recorded after an exposure period of 2, 4 and 6 hrs. The parasitoid exhibited differential susceptibility to endosulfan, cypermethrin, monocrotophos, dimethoate and neem seed kernel extract (NSKE). The order of safety index was NSKE > monocrotophos > endosulfan > dimethoate > cypermethrin.

Key words: *Trichogramma .brasiliensis*, insecticides, safety index, relative toxicity

INTRODUCTION

Parasitoids of the genus *Trichogramma* are important for the biological control of insect pests (Pratissoli *et al*., 2004 and 2005; Miranda *et al*., 1998). Trichogramma species are very much sensitive to pesticides. In India about 18 *Trichogramma* spp. are recorded of which *T.brasiliensis*, *T.chilonis* and *T.japanioum* are widely distributed and are key mortality factor for many crop pests. The *T. brasiliensis* attack eggs of pink bollworm, *Pectinophora gossypiella* Saunders, spotted bollworm, *Earias vitella* Biosd and American bollworm, *Helicoverpa armigera* Hubner. However, chemical control is still largely used if biological control fails and therefore it is necessary study about the associate use of insecticides with parasitoid. Sohi *et al*. (1997) and Singh (2000) evaluated 11 insecticides under field conditions and found carbaryl, cypermethrin, deltamethrin, endosulfan and monocrotophos to be comparatively less detrimental to the parasitoid. The present investigations were carried out to select insecticides that are not harmful to bioagents.

MATERIALS AND METHODS

The present investigations were carried out at Biocontrol Laboratory, Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. To study the relative toxicity (R.T), and safety index (S.I) of the selected insecticides *viz.*, endosulfan @ 0.07 % (Thiodan 35 EC), cypermethrin @ 0.006 % (Challenger 25 EC), monocrotophos @ 0.05 (Mophos 36SL), dimethoate @ 0.04% (Rogar 30 EC) and NSKE @ 5% that are recommended for tomato, okra and cotton (Krishnamoorthy and Krishna Kumar, 2001 and Atwal and Dhaliwal, 2002). Water sprayed control were maintained for comparison. The experiment was carried out under controlled condition in BOD incubator (27^{0}C, 65-85% RH, 14:10 (L: D) hrs). Each treatment was replicated five times. 20 freshly emerged (24hours old) adult parasitoid *Trichogramma brasiliensis* were released in glass vials already coated with thin film of different concentrations of insecticides. Observations on the mortality of the adults were recorded after an exposure period of 2, 4 and 6 hrs. The data thus generated on the per cent mortality under different treatments with different concentrations of selected insecticides were subjected to corrected per cent mortality by Abbott's formula and Log Dose Probit analysis for determining the LC_{50} value. The safety index of various insecticide formulations used against *T. brasiliensis* adults were calculated according to Regupathy *et al*., (2000) by using the following formula:

$$\text{Safety index} = \frac{LC_{50} \text{ Value of test insecticide}}{LC_{50} \text{ Value of a standard insecticide taken as a unit}}$$

RESULTS AND DISCUSSION

The safety index values were 7.0, 8.3 and 9.62 after 2 hrs of exposure for dimethoate, endosulfan and monocrotophos, respectively (Table 1). In case of cypermethrin, the LC_{50} value observed was 0.006 after 2 hrs of exposure. Thus, the acute toxicity of cypermethrin

is very high as indicated from its very low LC_{50} value. χ^2 value was calculated to be 0.90 and was non-significant at 5 per cent level of significance. Therefore, the toxicity in terms of safety index of cypermethrin was taken as the standard unit being highly toxic and was compared with other test insecticides for their relative safety to the parasitoid. Compared to cypermethrin, endosulfan registered a safety index of 8.30 after 2 hrs of exposure and was observed to be 0.122 times less toxic. LC_{50} value of monocrotophos was 0.0577 with lower and upper fiducial limits ranging from 0.035 to 0.31 per cent. Monocrotophos was calculated to be 0.010 fold less toxic to *T. brasiliensis* adults with a safety index of 9.62 compared to cypermethrin after 2 hrs of exposure. The probit analysis results showed a calculated LC_{50} (per cent) value of 0.042 for dimethoate with 7.0 as safety index. Dimethoate was observed to be 0.014 fold relatively less toxic to the parasitoid compared to the standard. NSKE, a botanical insecticide registered < 30 per cent mortality after 2 hrs of exposure, therefore no LC_{50} value was calculated for this hour of exposure. Thus, after 2 hrs of exposure the order of safety index evaluated for all the test insecticides against the adults of *T. brasiliensis* was monocrotophos > endosulfan > dimethoate > cypermethrin.

There was an increase in mortality as the exposure period increased from 2 to 4 hrs and 4 to 6 hrs. Four hours of exposure showed different results for dimethoate, showing LC_{50} value of 0.0375 with χ^2 value of 6.9 at 5 per cent level of significance (Table 2). It was 0.13 fold relatively less toxic to *T. brasiliensis* and showed safety index of 7.5 when compared with standard unit, cypermethrin. Thus, cypermethrin with LC_{50} value of 0.005 was again found to be more toxic to *T. brasiliensis* compared to rest of test insecticides at 4 hrs of exposure. Monocrotophos exhibited a safety index of 2.84 revealing that it is 2.84 times safer than cypermethrin when considered for the parasitoid safety point of view and 0.35 times relatively less toxic to the adults. LC_{50} value of monocrotophos was estimated to be 0.0142 with lower and upper fiducial limits ranging from 0.0119 to 0.0173 per cent. For endosulfan, the LC_{50} value was calculated to be 0.0205 with lower and upper fiducial limit ranging from 0.0155 to 0.0337 after 4 hrs of exposure. The safety index and relative toxicity was 4.1 and 0.25 respectively. A considerable mortality in NSKE was also found after 4 hrs of treatment. However, compared to other test insecticides, NSKE exhibited relatively high LC_{50} 0.148 compared to conventional insecticidal compounds. The increasing order of safety index of selected insecticides where adults were exposed for 4 hrs was cypermethrin < monocrotophos < endosulfan < dimethoate < NSKE where NSKE showed maximum safety index of 29.6 and lowest toxicity with 0.03 compared to standard unit which was taken as one.

After an exposure of 6 hrs the results have drastically different from the results compared to 2 hrs of exposure period. Cypermethrin still was found to be highly toxic with a LC_{50} value of 0.003 (Table 3). Compared to cypermethrin, monocrotophos registered a safety index of only 2.67 and was 0.37 times relatively less toxic with an LC_{50} value of 0.008 per cent. Although dimethoate stand second in ranking in terms of safety index after 2 hrs of exposure but after 6 hrs it was come down to 4^{th} position with a safety index of 6.9. Dimethoate registered LC_{50} value of 0.0207 against *T. brasiliensis* with fiducial limits ranging from 0.0157 to 0.0412 per cent. The safety index and LC_{50} values for NSKE after 6 hrs of exposure were recorded to 19 and 0.057, respectively. Thus after an exposure period of 6 hrs the order of safety index of all the test insecticides to *T. brasiliensis* was cypermethrin < monocrotophos < endosulfan < dimethoate < NSKE.

The five selected insecticides clearly manifested the toxicity of chemicals. Cypermethrin had lowest safety index and high relative toxicity, where as NSKE was found to have high safety index. For *T. brasiliensis*, the order of S.I of selected insecticide was cypermethrin followed by monocrotophos < endosulfan < dimethoate and NSKE. Navarajan (1988) results favor our findings, where they observed that monocrotophos, endrin, phosalone and endosulfan were relatively safe to *Trichogramma* in comparison to cypermethrin. Similarly, Bhuvaneswari and Uthamasamy (1994) reported high relative toxicity of cypermethrin to *T.chilonis* (Regupathy *et.al*, 2000). In present study the selected insecticides cypermethrin in both calculation was found toxic, whereas dimethoate and NSKE were relatively safe for *T. brasiliensis* Endosulfan and monocrotophos was less toxic to biogents. Vianna *et al.,* (2009) reported that pyrethroid insecticides presented great reduction on the parasitisation rate and per cent emergence of individuals of *T. pretiosum* on tomato. Though the increasing exposure period showed lower value of LC_{50} yet the order of relative toxicity of insecticides remained same. In all the exposure periods 2, 4 and 6 hrs, cypermethrin had lowest safety index and high relative toxicity, whereas NSKE was found to have high safety index in 4 and 6 hrs of exposure period. Among the selected insecticides NSKE was least toxic compared to synthetic insecticides. It can be concluded from this objective that higher the exposure period more will be mortality. Cypermethrin recorded as relatively more toxic and gave low safety index to *T. brasiliensis* in comparison to monocrotophos, endosulfan, dimethoate and NSKE.

Table 1. Safety index of different insecticides used for *T. brasiliensis*, an egg parasitoid of *H. armigera* when exposed for 2 hours

Treatment	a.i. (%)	Regression equation	LC_{50} (%)	Fiducial limits	Heterogeneity	Safety index	Relative toxicity
Endosulfan	Thiodan 35 EC (0.07)	Y=4.214+1.612(x+1.789)	0.049	0.0269-0.092	01.618	8.3	0.122
Cypermethrin	Challenger 25 EC (0.006)	Y=4.303+4.751(x+2.352)	0.006	0.0052-0.009	0.900	1.0	1.0
Monocrotophos	Mophos 36SL (0.05)	Y=4.255+1.830(x+1.659)	0.057	0.0350-0.310	10.932	9.62	0.010
Dimethoate	Rogar 30 EC (0.04)	Y=3.853+4.609(x+1.615)	0.042	0.0330-0.069	03.975	7.0	0.014

Table 2. Safety index of different insecticides used for *T. brasiliensis*, an egg parasitoid of *H. armigera* when exposed for 4 hours

Treatment	a.i (%)	Regression equation	LC_{50} (%)	Fiducial limits	Heterogeneity	Safety Index	Relative toxicity
Endosulfan	Thiodan 35 EC(0.07)	Y=4.595+2.051(x+1.882)	0.020	0.015-0.033	19.164	4.1	0.25
Cypermethrin	Challenger 25 EC (0.006)	Y=4.537+4.842(x+2.360)	0.005	0.004-0.006	01.347	1.0	1.0
Monocrotophos	Mophos 36SL(0.05)	Y=4.898+3.371(x+1.875)	0.014	0.011-0.017	07.558	2.84	0.35
Dimethoate	Rogar 30 EC(0.04)	Y=4.265+3.380(x+1.64)	0.037	0.030-0.054	06.900	7.50	0.13
NSKE	Home made (5.00)	Y=4.400+1.808(x+1.159)	0.148	0.096-12.65	02.180	29.60	0.033

Table 3. Safety index of different insecticides used for *T. brasiliensis*, an egg parasitoid of *H. armigera* when exposed for 6 hours

Treatment	a.i (%)	Regression equation	LC_{50} (%)	Fiducial limits	Heterogeneity	S.I	R.I
Endosulfan	Thiodan 35 EC(0.07)	Y=4.930+1.980(x+1.990)	0.011	0.008-0.016	30.14	3.66	0.27
Cypermethrin	Challenger 25 EC (0.006)	Y=5.184+4.662(x+2.444)	0.003	0.002-0.003	09.393	1.0	1.0
Monocrotophos	Mophos 36SL(0.05)	Y=4.725+2.280(x+2.183)	0.008	0.006-0.016	40.656	2.67	0.37
Dimethoate	Rogar 30 EC(0.04)	Y=4.275+3.022(x+1.922)	0.020	0.015-0.041	23.202	6.90	0.15
NSKE	Home made (5.00)	Y=5.197+5.030(x+1.202)	0.057	0.040-0.060	08.29	19.0	0.05

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