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The Side-effects of Pesticides on *Trichogramma cacoeciae* Marchal (Hymenoptera: Trichogrammatidae), an Egg Parasite

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Abstract: The standard methods of IOBC/WPRS were followed to test Vertimic at 1.47 µL, 0.735 µL, Dimethoate at 25.00 µL, 12.50 µL, 6.25 µL, Kumulus at 0.675 µL, 0.336 µL and Touchdown at 156.00 µL, 78.00 µL, 39.00 µL for their side-effects on *Trichogramma cacoeciae* Marchal. The adult parasites were exposed to fresh pesticide residues. The control was sprayed with tap water. The results showed that these chemicals differed markedly in their toxicity. Among the tested pesticides, Dimethoate at 25.00 µL, 12.50 µL and 6.25 µL gave total mortality of the parasite compared to water treated control. It reduced the parasitism by 100 percent. Hence, categorized as harmful. Vertimic at 1.47 µL was slightly harmful with 57.37% reduction in parasitism. The remaining pesticides, Vertimic at 0.735 µL, Kumulus at 0.675 µL, 0.336 µL, Touchdown at 156.00 µL, 78.00 µL, 39.00 µL were harmless and did not differ with water treated control. These are more suitable for the use in Integrated Pest Management (IPM).

Key words: Side-effects, Pesticides, *Trichogramma cacoeciae* Marchal, Endo-parasite, Germany

Introduction

The world-wide parasites of the genus *Trichogramma* play a vital role as natural enemies of lepidopterous pests on a wide range of agricultural crops. The genus includes about 40 species which are exclusively endo-parasites. Since *Trichogramma* parasitizes the eggs of lepidopterons and prevents damage caused by their larvae, it has been successfully used in practical biological control and gained widespread interest in many countries. About 10 different *Trichogramma* species are being mass reared to control pests on corn, sugar-cane, rice, cotton, soybean, sugar-beet, vegetables and pine in at least 13 countries. It is reported that *Trichogramma cacoeciae* Marchal [Hymenoptera; Trichogrammatidae] has a great potential and plays a significant role for different lepidopterous pests control (Hassan, 1993).

Indiscriminate and overuse of pesticides is not only continuously destroying the environment but also is hazardous for parasites and predators. The use of pesticides in IPM system requires a prior assessment of their possible side effects on beneficial organisms. Testing the side-effects of pesticides on beneficial arthropods is gaining attention by research workers in different parts of the world. Suitable breeding techniques and standard test methods for pesticide effects on beneficial organisms are urgently needed for sound IPM. The side-effects of pesticides on *T. cacoeciae* Marchal have been studied (Franz *et al.,* 1980; Hassan, 1986; Hassan *et al*., 1983; 1987; 1988; 1994). However, the effects of pesticides on *T. cacoeciae* Marchal have not been tested in Pakistan. At present it is of great importance to control crop pests biologically and use only those pesticides which are less harmful for beneficial organisms. Therefore, keeping in view the importance of parasitoid, *T. cacoeciae* Marchal, the present studies were conducted in an attempt to determine the side-effects of four major pesticides viz:, Vertimic, Kumulus, Touchdown and Dimethoate on *T. cacoeciae* Marchal with the objective to find out the safer and harmless pesticides which can easily be confirmed under practical conditions in the field and can be used along with biological control.

Materials and Methods

The study was conducted at Federal Biological Research Centre for Agriculture and Forestry (BBA), Institute for Biological Pest Control, Darmstadt, Germany, during 1997-98. Four pesticides viz:, Vertimic at 1.470 µL, 0.735 µL, Dimethoate at 25.00 µL, 12.50 µL, 6.25 µL, Kumulus at 0.675 µL, 0.336 µL and Touchdown at 156.00 µL, 78.00 µL, 39.00 µL, replicated thrice were tested for their side-effects on adult *T. cacoeciae* in laboratory. The control was sprayed with tap water. Each pesticide was applied on glass plates (1 to 1.5 mg fluid/cm square). The margin on the glass plates were left untreated by covering each glass plate with a 14×14 cm square plastic frame leaving the central area of 10×10 cm square during spraying. The glass plates were then dried up for 3 hours. The treated glass plates were fitted on to an aluminum frame of the same size and cages were assembled by using these plates. The experiments were carried out using standard methods of the IOBC/WPRS Working Group (Hassan, 1977; 1992).

The experiment commenced with a 24 hours period of forced exposure. Honey was supplied on a narrow strip of paper as a food. After 24 hours forced exposures, the parasites were given host eggs to measure their parasitization capacity. About 5000 *Sitotroga cerealella* eggs were provided on 2nd, 3rd and 5th day of the experiment. Honey was added as food each time beside the host eggs. At the end of the 7th day, the cages were dismounted from the sucking pump and *Sitotroga* egg stripes were kept between sheets of paper in the climatic chamber for counting the parasitized eggs. The parasitized eggs were heated at 70°C for about 30 minutes which stops the *Trichogramma* from emerging without affecting the black coloring of the parasitized eggs. The number of host eggs parasitized during the course of the experiment was counted. The parasitization capacity per *Trichogramma* adult female for each cage and average for all replicates was calculated.

The initial toxicity was tested by exposing the adult parasites of *T. cacoeciae* to a fresh dry pesticide film on glass plates. After 24 hours period of forced exposure on pesticide residues, the parasites were offered *S. cerealella* eggs to measure their ability to parasitize. The number of parasitized eggs is counted for each cage. The percent mean parasitism per cage per egg strip per female present is calculated. For each test product, the mean reduction in parasitism is calculated as a percentage of the control. The reduction in parasitization during the 7 day test was compared with control for measuring the effect of the chemicals. The reduction in parasitization as compared with control (Treated with water) was used to measure the effect of the chemicals. The pesticides tested are then classified for initial toxicity into one of the following categories according to the degree of reduction in parasitization; <50 percent: harmless; 50-79 percent: slightly harmful; 80-99 percent: moderately harmful and >99 percent: harmful. Evaluation of toxicity has been done as coded by International Organization for Biological Control IOBC (1994). Products reducing the capacity of parasitism by less than the accepted threshold value (50%) can be classified as harmless, and need not to be tested further. Products reducing the capacity of parasitism by more than the accepted threshold value should pass on the next test in the scheme.

Results and Discussion

The tested chemicals differed markedly in their toxicity and parasitism (Table 1). Dimethoate gave total mortality of the egg parasite after a 24 hours period of forced exposure. Therefore, no parasitism was observed. The start population ranged from 102 to 163 *T. cacoeciae*. Total parasitism observations are based on II, III and IV day of parasitized *Sitotroga* eggs by *T. cacoeciae*. The highest total parasitism was recorded of the control followed by Touchdown at 39.00 µL and Touchdown at 78.00 µL. The average parasitism of *T. cacoeciae* was ranged between 12.20 and 20.77 compared to 19.20 of the water treated control. The highest average parasitism was recorded when Kumulus was sprayed at the rate of 0.336 µL followed Kumulus at 0.675 µL and control. While the lowest parasitism was noticed in the treatment where Vertimic at 1.470 µL was applied. It is also clear from these results that with the decrease in the concentration of the pesticides, the average parasitism of *T. cacoeciae* is increased. The side-effects were minimized when these pesticides are applied at lower concentrations.

Reduction of parasitism ranged from 1.59 to 100% but Kumulus at 0.675 µL and 0.336 µL increased the parasitism by 0.05 and 7.59 percent, respectively compared to control (Table 2). The mortality caused by Dimethoate at 25.00 µL, 12.50 µL and 6.25 µL was 100 percent. Since the mortality was greater than 99 percent, therefore according to IOBC categorization, Dimethoate is grouped as harmful for *T. cacoeciae*. In case of a harmful classification the degree of realism is gradually upgraded to the level of field test (Hassan and Oomen, 1985; Samsoe-Petersen, 1990). However, Oomen (1988) and Backker *et al*. (1992) argue that in the case of Phytoseiid mites the lab test can also be used to classify products as harmful with out further testing. The pesticide, Vertimic at 1.47 µL gave a reduction of 57.37% in parasitism and was therefore, categorized as slightly harmful. However, Vertimic at 0.735 µL, Kumulus at 0.675 µL, 0.336 µL, Touchdown at 156.00 µL, 78.00 µL, 39.00 µL and the water treated control was fallen in harmless category as they gave less than 50 percent reduction in parasitism of *T. cacoeciae*.

Result of the present work showed that under the laboratory conditions, Vertimic at 1.47 µL was slightly harmful. However, Vertimic at 0.735 µL, Kumulus at 0.675 µL, 0.336 µL, Touchdown at 156.00 µL, 78.00 µL, 39.00 µL were harmless. The pesticide, Dimethoate at 25.00 µL, 12.50 µL, 6.25 µL was toxic and rated as harmful to *T. cacoeciae* Marchal. Therefore, further testing of Vertimic at 1.47 µL and Dimethoate at 25.00 µL, 12.50 µL, 6.25 µL for semi-field and field conditions is recommended. Consequently, farmers and crop protectionists are suggested to minimize their application and alternative control measures should be explored out for the control of lepidopterous pests.

Table 1: The side-effects of pesticides on *Trichogramma cacoeciae*, an egg parasite

	Concentration	Kind of Pesticide	No. of *T. cacoeciae*	No. of Parasitized *Sitotroga* eggs on 2nd	3rd	4th day	Total Para-sitism	Ave. Parasitism /female
Control	Water sprayed		148	2508	224	109	2841	19.20
Vertimic	1.470 µL	Insecticide	137	1473	155	44	1672	12.20
-do-	0.735 µL	-do-	145	1659	156	49	1864	12.86
Dimethoate	25.00 µL	Insecticide		Total Mortality of the parasite, *T. cacoeciae*				
-do-	12.50 µL	-do-					-do-	
-do-	6.25 µL	-do-					-do-	
Kumulus	0.675 µL	Fungicide	115	1880	237	92	2209	19.21
-do-	0.336 µL	-do-	102	1878	170	71	2119	20.77
Touchdown	156.00 µL	Herbicide	148	1976	106	130	2212	14.95
-do-	78.00 µL	-do-	163	2356	147	149	2652	16.27
-do-	39.00 µL	-do-	150	2514	145	175	2834	18.89

Table 2: The pesticides toxicity on *Trichogramma cacoeciae* and evaluation of their categories

Pesticides cides	Concentration	Kind of Pesticide	No. of *T. cacoeciae*	Ave. Para-sistism/female	% Reduction in Parasitism	IOBC* Category
Control	Water	Water 148	19.20		0.00	1
Vertimic	1.470 µL	Insecticide	137	12.20	57.37	2
-do-	0.735 µL	-do-	145	12.86	49.30	1
Dimethoate	25.00 µL	Insecticide	Total Mortality of the		100.00	4
-do-	12.50 µL	-do-	parasite, *T. cacoeciae*		100.00	4
-do-	6.25 µL	-do-	-do-		100.00	4
Kumulus	0.675 µL	Fungicide	115	19.21	-0.05**	1
-do-	0.336 µL	-do-	102	20.77	-7.59**	1
Touchdown	156.00 µL	Herbicide	148	14.95	28.43	1
-do-	78.00 µL	-do-	163	16.27	18.01	1
-do-	39.00 µL	-do-	150	18.89	1.59	1

* According to International Organization for Biological Control (1994), 1 = <50%: harmless; 2 = 50-79%: slightly harmful; 3 = 80-99%: moderately harmful and 4 = >99%: harmful.

** Increased parasitism compared to control

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