Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-7: 4548-4552

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 Special Issue-7 pp. 4548-4552
Journal homepage: http://www.ijcmas.com

Original Research Article

Efficacy of Novel Insecticides and Botanicals against Parasitization of *Trichogramma chilonis*

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A B S T R A C T

The present investigations were undertaken, during the year 2014 and 2015 in the bio-control laboratory, Department of Entomology, CSA University of Agriculture and Technology, Kanpur. Effect of persistent toxicity of different insecticides and plant products on parasitization and emergence of *Trichogramma chilonis* from parasitized *Corcyra* eggs revealed that *Parthenium* leaf extract 5% caused maximum egg parasitization of 70.00% in 2014 and 66.00% in 2015. Lowest parasitization (33.00% in 2014 and 29.5% in 2015) was found in *Corcyra* eggs treated with imidacloprid 17.8 SL. The emergence of *T. chilonis* was observed from 8 days after treatment (DAT) onwards and the overall emergence was maximum at 12 DAT. In this experiment *Parthenium* leaf extract 5% and azadirachtin 5% were found most promising when compared with other insecticides with 75.71% and 70.67% emergence, respectively, during the year 2014 and 73.48% and 67.18% emergence, respectively, during the year 2015. The least emergence of adult parasitoid was observed in treatment with imidacloprid 17.8SL (53.03% in 2014 and 52.54% in 2015), followed by emamectin benzoate 5SG (56.71% in 2014 and 56.45% in 2015).

Keywords

Trichogramma chilonis, *Corcyra cephalonica*, *Parthenium* leaf extract, Azadirachtin, Spinosad, Emamectin benzoate, Imidacloprid

Introduction

Bio-control have been a boon to primitive agriculture and have been economically successful in modern progressive intensive agriculture. Bio-control can be used against any type of pest and works best as part of an integrated approach for the management. *Trichogramma* are minute polyphagous wasp, commonly known as stingless wasps, that are endoparasitoids of insect eggs. Endoparasitoids lay their eggs in eggs or larvae of other species. *Trichogramma*, an egg parasitoid can be used in controlling many lepidopteron pests and other species such as hymenoptera, neuroptera, diptera, coleoptera and hemiptera. The parasitoids are mass-reared on the eggs of rice meal moth, *Corcyra cephalonica* a storage pest which is being mass reared on sorghum/maize broken grains. *Trichogramma* represent around 80 genera from the trichogrammatidae family with over 800 species worldwide.

The role of *Trichogramma* spp. in biological control programme is well understood. Its use in ecosystems has achieved appreciable success. Now with the onset of bio-intensive pest management programme (BIPM), emphasis has changed from using bio-control agents alone to integrate the use of bio-agents, such as *Trichogramma* spp. with other control methods, without reducing the efficiency of bio-control agents. Broad spectrum insecticides, because of their promising attributes like immediate knock down effect, reliability and ease in availability and use, positioned at an important level in BIPM programme. Hence, need arises to evaluate the insecticides that are harmful to the insect pests, but safe to the natural enemies and human beings. Large number of insecticides has been screened for their comparative safety to natural enemies in different parts of the world. Numbers of studies have been focused on the effect of pesticides on *Trichogramma* spp.

The excessive and indiscriminate use of insecticides resulted in high pesticide residues in food, development of resistance in insect pests, pest resurgence, and ill effects on human health, killing of non-target organisms and food chain toxicity to natural enemies like parasitoids and predators (Paroda, 2001). Several commercial crops, vegetables and stored grain receive about 80-90 per cent of the total pesticide usage in India (Anonymous, 2004). Keeping these points in view and importance of quality produce of food grain under W.T.O. regime, it is necessary to manage the pest population through IPM programme. In IPM programme we cannot ignore the role of pesticides immediately, because we have to cope up the pest alarming situation. The role of biological control agents in this system with better attributes is very important (Chopra, 2001). Trichogrammatid egg parasitoids are considered to be the most useful biological control agents for inundative releases against lepidopteron pests. One major purpose of Integrated Pest Management (IPM) strategies is to unify the safe and sustainable use of chemical and biological control method. Therefore the side effects of pesticides on biocontrol agent should be evaluated for induction in IPM programmes.

Materials and Methods

The *Corcyra* eggs thus found from laboratory culture were sterilized by exposing to U.V. light (15 watt for 1hour) to kill the embryo. The large egg cards (15 cm x 7.5 cm) were divided in to 10 rectangles (3 cm x 2 cm) and thin layer of diluted Acacia gum was applied for pasting the *Corcyra* eggs sprinkled uniformly on the card @ 1.00c.c per card. The cards were then allowed to dry in shade. The pasting of eggs was done with the help of camel hair brush. The card was kept in large polythene bag (30 cm x 20 cm) containing nucleus egg cards (the adults about to emerge from parasitized eggs) at a ratio of 1:5 to fresh eggs for parasitization at room conditions with temperature of 27 ± 2^0C and 65 ± 5 % relative humidity. Adults were allowed to parasitize the eggs for two days, on fourth day parasitized eggs turned black in color. At this stage, egg cards strip of suitable size was kept for adult emergence in separate test tubes and emerged adults were utilized in different toxicological experiments. Newly emerged adults were provided with 50 per cent honey solution in the form of honey streak as adult food inside the test tube.

The plant extract were formulated in distilled water to prepare 5% concentration. Investigation were evaluated using concentration of these plant extract under laboratory condition on the card. For this, the card (2.0 ×× 2.0 cm with 50 eggs per card) were sprayed with liquid using a manually operated atomizer at the rate of 1 ml spray liquid per card. Then, the sprayed cards were allowed to dry in shade for half an hour and were introduced in glass tube (15×7.5 cm$\times 7.5$ cm) plugged with cotton. The treated egg cards were exposed to 5 pairs of *Trichogramma chilonis* per cards of 50 eggs for 24hrs.

The recommended concentrations of the insecticides were tested initially against the host of the bio-control agent in laboratory. Stock solutions of formulated insecticides were prepared in distilled water according to their respective doses. A control treatment (distilled water) was included in each test to assess the natural mortality of the test insects.

The trichocard ($2^{\times\times}$2cm) with approximately 50 *Corcyra cephalonica* eggs each were offered for 24 hr to freshly emerged *T. chilonis* adults in glass tubes($15^{\times\times}$7.5 cm). These cards were sprayed with 1 ml of insecticide in different concentration with atomizer. All the test units were kept in controlled conditions in BOD incubator at 27 ± 2^{0}C and 65 ± 5% R.H. The data recorded on parasitized eggs at 4^{th}, 5^{th}, 6^{th}, 7^{th} and 8^{th} days after treatment (DAT) and adults emergence recorded at 8^{th}, 9^{th}, 10^{th}, 11^{th} and 12^{th} days after parasitization. These experiments were carried out in completely randomized design (CRD) with four repeats.

In untreated control, eggs were sprayed with distilled water. Observations were recorded for per cent parasitisation from 3^{rd} day onwards.

The per cent parasitisation of eggs was distinguished by blackening of the eggs (Raguram and Singh, 1999). The emergence and survival per cent was observed from 8-12 days after parasitisation. Parasitoids emerging out from the eggs and empty egg shells were recorded as alive.

Results and Discussion

Studies were conducted in the laboratory on the parasitization of the treated *Corcyra* eggs with *T. chilonis*. The data were recorded from 4^{th}, 5^{th}, 6^{th}, 7^{th} and 8^{th} days after treatment. The results on per cent parasitization revealed that *Parthenium* leaf extract 5% caused maximum egg parasitization of 70.00% during 2014 and 66.00% in 2015.This was at par to azadirachtin 5% which gave slightly lower parasitization of 66.50% and 64.00% in 2014 and 2015, respectively.

However, all the treatments were inferior to control which gave 85.50% parasitization in 2014 and 82.50% parasitization in 2015. Lowest parasitization (33.00% in 2014 and 29.5% in 2015) was found in egg cards treated with imidacloprid 17.8% SL. The per cent parasitization was higher in treatments with plant products. The efficacy of different insecticides and plant products with respect to parasitization was *Parthenium* leaf extract 5% > azadirachtin5% > spinosad 45 SC > emamectin benzoate 5 SG > imidacloprid 17.8 SL (Table-1).

All the above results indicated that majority of insecticides adversely affected the parasitization of *T. chilonis* while new chemistry molecule emamectin benzoate and microbial insecticide spinosad were found safer with lesser effect as compared to imidacloprid. However, botanicals were proved to be more protective to parasitoid.

These results agree to the work of Hussain *et al.,* (2010) who reported emamectin benzoate and imidacloprid to be safer to *T. chilonis*. Singh *et al.,* (2015) observed botanical pesticides *viz.* NSKE 5%, Neem gold (commercial product) 5% were also safer to the parasitoid.

Table.1 Effect on parasitization by *Trichogramma chilonis* on treated *Corcyra* eggs during the year 2014 and 2015

S. N.	Treatment	No. of parasitized eggs out of 50 eggs										Parasitization (%)	
		4 DAT		5 DAT		6 DAT		7 DAT		8 DAT			
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
1	Imidachloprid 17.8 SL	1.50	1.25	5.25	5.00	7.25	6.75	12.25	9.75	16.50	14.75	33.00	29.50
2	Spinosad 45 SC	2.50	2.00	6.75	5.75	8.75	8.75	14.50	12.50	18.50	15.75	37.00	31.50
3	Emamectin Benzoate 5 SG	2.00	1.75	6.00	5.50	8.00	7.50	13.50	10.75	16.75	15.50	33.50	31.00
4	Azadirachtin 5%	4.00	3.50	9.75	7.50	13.75	10.25	25.00	22.25	33.25	32.00	66.50	64.00
5	*Parthenium* leaf extract 5%	4.50	3.75	10.25	8.50	19.00	11.50	27.25	24.75	35.00	33.00	70.00	66.00
6	Control	5.25	4.75	12.00	11.75	19.75	14.25	28.25	28.75	42.75	41.25	85.50	82.50
	SE (m)± CD at 5%	**0.468 1.390**	**0.553 1.642**	**0.920 2.735**	**1.057 3.142**	**1.047 3.112**	**1.126 3.345**	**1.556 4.622**	**0.977 2.903**	**1.324 3.934**	**1.126 3.345**		

DAT= Days After Treatment

Table.2 Effect of persistent toxicity of different insecticides on emergence of *Trichogramma chilonis* from parasitized *Corcyra* eggs during the year 2014 and 2015

S. N.	Treatment	Adult Emergence out of 50 eggs										Emergence (%)	
		8 DAT		9 DAT		10 DAT		11 DAT		12 DAT			
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
1	Imidachloprid 17.8% SL	1.50	1.25	4.00	3.25	5.75	5.00	7.75	7.25	8.75	7.75	53.03	52.54
2	Spinosad 45% SC	2.75	2.50	5.50	5.25	8.00	7.25	10.25	9.00	10.75	9.50	58.10	60.31
3	Emamectin Benzoate 5% SG	2.00	2.00	4.75	4.00	6.50	6.25	8.25	8.25	9.50	8.75	56.71	56.45
4	Azadirachtin 5%	9.50	8.25	15.00	12.25	18.25	15.75	21.25	20.25	23.50	21.50	70.67	67.18
5	*Parthenium* leaf extract5%	11.00	9.00	16.00	14.25	19.75	17.25	25.00	23.00	26.50	24.25	75.71	73.48
6	Control	14.75	15.25	22.25	21.00	29.00	27.25	33.25	33.50	38.25	38.00	89.47	92.12
	SE (m)± CD at 5%	**0.997 2.961**	**1.036 3.078**	**0.917 2.724**	**1.112 3.303**	**1.162 3.453**	**1.079 3.204**	**1.258 3.739**	**1.186 3.523**	**1.186 3.523**	**1.529 4.542**		

DAT= Days After Treatment

The emergence of *T. chilonis* was observed from 8 DAT onwards and the overall emergence was maximum at 12 DAT. In this experiment *Parthenium* leaf extract 5% and azadirachtin 5%with 75.71% and 70.67% emergence, respectively that were found most promising when compared with other insecticides during the year 2014. During the year 2015, it was recorded as 73.48% and 67.18% emergence, respectively. The least emergence of adult parasitoid was observed in treatment with imidacloprid 17.8% SL (53.03% in 2014 and 52.54% in 2015) followed by emamectin benzoate 5% SG (56.71% in 2014 and 56.45% in 2015).

The safety of different insecticides and plant products on emergence of the parasitoid was in the following sequence, *Parthenium* leaf extract 5% > azadirachtin 5% > spinosad 45% SC > emamectin benzoate 5% SG > imidacloprid 17.8% SL (Table-2).

Similar result had conformed these findings as shown by Fand *et al.,* (2009) observed that azadirachtin 5% did not adversely affect the development and emergence of parasitoid although it had reduced the parasitization. Halappa *et al.,* (2012) observed that imidacloprid showed the highest toxicity to *T. chilonis* with LC_{50} of 0.0003% which were followed by indoxacarb (0.0004%). Kumar *et al.,* (2016) found emamectin benzoate, profenofos, cypermethrin, lambdacyhalothrin, imidacloprid, thiamethoxam, propargite and abamectin to be harmful (IOBC class-4>99% mortality), against immature stages (inside the host eggs), insecticides though showed toxicity, none was found harmful.

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