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Insecticides effect on biotic potential on *Corcyra cephalonica* eggs by *Trichogramma chilonis*

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Abstract
Investigations were carried out to assess the biotic potential by *T. chilonis* on eggs of *Corcyra cephalonica* by applying different insecticides chlorantraniliprole 18.5 SC, profenofos 50 EC, cartap hydrochloride 50 SP, spiromesifen 22.9 SC, buprofezin 25 SC, flubendiamide 20% WG, azadirachtin 1500 ppm and lambda cyhalothrin 9.5% + thiamethoxam 12.6% ZC on host egg. The bioassay studies under laboratory conditions were carried out to determine the insecticides effect on parasitization by *T. chilonis* on insecticide treated factitious host eggs of *Corcyra cephalonica* Stainton. For the experiments biotic potential, un-irradiated eggs of host insect i.e. *Corcyra cephalonica* were used. The results on biotic potential studies revealed that the maximum percent parasitization of *Trichogramma chilonis* was obtained in the treatment of azadirachtin 1500 ppm whereas lowest in the treatment of cartap hydrochloride 50 SP. The other relatively harmless insecticides were chlorantraniliprole 18.5 SC and flubendiamide 20% WG in which > 50 percent parasitization was obtained and categorized as harmless and slightly harmful respectively.

Keywords: *Trichogramma chilonis*, *Corcyra cephalonica*, parasitization

Introduction
Bio-control have been a boon to primitive agriculture and have been economically successful in modern progressive intensive agriculture. Any form of pest can be controlled using bio-control, but it works best when used in conjunction with an integrated pest management strategy. In biological control *Trichogramma* are most widely used parasitoid species worldwide (Khan *et al.*, 2015, Parreira *et al.*, 2019) [23, 2]. According to reports, the parasitic wasps have been dispersed annually across an estimated 80 million acres of agricultural land and forests in 30 nations to combat significant insect pests in crops like corn, rice, cotton, sugar beet, tomatoes, vegetables, and orchards. (Li, 1994; Khan *et al.*, 2015, Hassan, 1993; Smith, 1996; Khan *et al.*, 2014) [3, 23, 4, 6, 1].
Trichogramma chilonis (Ishii) has been used successfully in augmentation all over the world and have capacity of controlling more than 400 pest species, the majority of which are lepidopteran pests. (Lingathurai *et al.*, 2015; Pinto and Stouthamer, 1994) [7-8]. They are widely distributed throughout the Indian subcontinent (Manjunath *et al.*, 1985; Ananthakrishnan *et al.*, 1991; Khan *et al.*, 2014) [9, 10, 1]. They control pests including *Chilo* spp. in sugarcane, maize, and *Helicoverpa armigera* in cotton, tomato, and lady's finger in India (Singh, 2001) [11]. In Pakistan, it is an important egg parasitoid of lepidopteran pests (Sattar *et al.*, 2011; Khan *et al.*, 2014) [12, 1]. It successfully manages some of the common hosts i.e., sugarcane borer (*Chilo sacchariphagus indicus*) in sugar cane, diamondback moth (*Plutella xylostella*), (Linnaeus) in cabbage and other vegetables and cotton bollworms (*Helicoverpa armigera*) in cotton and corn (Rasool *et al.*, 2002) [13]. *T. chilonis* is an effective parasitoid of rice leaf folder *Cnaphalocrocis medinalis* (Guenee) in Pakistan (Sagheer *et al.*, 2008) [14]. IPM strategies integration of the sustainable and safe use of chemical and biological control methods is one of their main goals. Keeping the natural predators in the agro-ecosystem alive requires avoiding the use of harmful insecticides. Hence the present study was conducted to evaluate the biotic potential on *Corcyra cephalonica* eggs by *T. chilonis.*

Material and Method
The present study on effects of insecticides on parasitization of Corcyra cephalonica residual toxicity of newer insecticides against the egg parasitoid *T. chilonis* was carried out at Bio control laboratory, College of Agriculture Nagpur. The experiments were carried by using

a completely randomized experimental design with 9 different treatment replicating 3 times.

To assess the Biotic Potential of *Trichogramma chilonis* on *Corcyra* eggs.

Experiment was conducted to find out the optimum storage temperature and duration for the parasitoid. Nucleus culture of *T. chilonis* was procured from Bio control lab College of Agriculture, Nagpur. Separately, 50 fresh *Corcyra cephalonica* eggs that had not been radioactively contaminated were adhered to egg cards. The cards were divided into 5.0 x 2.0 cm strips and submerged in test pesticides for 5 seconds. Water was utilized to maintain control instead of insecticides. Shade drying was done on the treated egg cards. For each treatment and replication, one card strip containing U.V.-unexposed eggs was stored in a glass vial measuring approximately 15.0 x 2.5 cm in size. Following that, each treatment was appropriately labelled with information such as its name, pesticide concentration, application date and time, etc.

The treated egg-cards were given 24 hours of parasitization exposure to adults of *Trichogramma chilonis* (@ 5:1 host: parasitoid ratio). The investigation was carried out in a laboratory environment with three replications of each treatment. After the fifth day of parasitoid release, the egg cards were checked for parasitism. The number of parasitized eggs was counted using a stereozoom microscope, and the percentage of parasitism was calculated using the formula below:

$$\text{Per cent parasitization} = \frac{\text{Number of eggs parasitized}}{\text{Total number of eggs exposed}} \times 100$$

The percent reduction in parasitism (RP) will be determined for each insecticide by the equation

$$RP\ (\%) = (1\text{-}f/t) \times 100$$

Where,

f= average number of parasitized eggs in the insecticide treatment

t=average number of parasitized eggs in the control treatment (Hassan *et al.* 2000) [25]

Statistical analysis

Data recorded during present study on biotic potential on eggs of *Corcyra cephalonica* by *T. chilonis* were Statistically analyzed by using OPSTAT software which is available online on Hissar Agricultural University, Hissar

Results and discussion

Parasitization of UV un-irradiated eggs

The data on effect of newer insecticides applied on untreated eggs of *C. cephalonica* on parasitization by *T. chilonis* are presented in Table 1 and showed in Fig. 1. Amongst the insecticides, highest parasitization was recorded in azadirachtin 66.66 percent followed by chlorantraniliprole 64.00 percent which were found statistically at par with each other as compare to control 86.66 percent parasitization. After chlorantraniliprole 64.00 percent the next safer insecticide was flubendiamide 60.00 percent, both were found at par with each other. The next relatively safer insecticides was recorded in treatment profenofos and spiromesifen with 49.33 and 44.66 percent parasitization, respectively both were at par with each other followed by buprofezin with 35.33 percent parasitization. However, lowest parasitization was recorded in cartap hydrochloride 8.00 percent followed by lambda cyhalothrin + thiamethoxam with 10.66 percent at par with each other.

Based on the percent reduction in parasitization over control flubendiamide, profenofos, spiromesifen and buprofezin recorded with 30.77, 43.08, 48.46 and 59.23 percent, respectively which were categorized as slightly harmful while azadirachtin 23.07 percent and chlorantraniliprole 26.15 percent categorized as harmless. From the above results, cartap hydrochloride and lambda cyhalothrin + thiamethoxam seems to be the moderately harmful insecticides to the adult parasitoid inhibiting the parasitization efficiency whereas azadirachtin and chlorantraniliprole seems the harmless with no effect on the parasitization efficiency.

The result envisages that the insecticide azadirachtin favoured greater percent of egg parasitization and based on the percent decrease in parasitization over control it is classified as safer compound to *T. chilonis*. The result of present study are in accordance with the findings of Asifulla *et al.* (1998) [24] and Thakur and Pawar (2000) [15] who reported neem products safer to *T. chilonis* as compared to insecticides based on the rate of parasitization. Borah *et al.* (2001) [16] reported two *azadirachta indica* products (Neemazal-F and fortune Aza) found less detrimental effect on the parasitoids, resulting in fairly high degree of parasitism which supported to our findings. Lyson *et al.*, (2003) [17] observed 50-60 percent parasitization in azadirachtin treated eggs of *E. kuhniella* which is slightly lower recorded with 66.66 percent parasitization in our present findings. Gandhi *et al.* (2005) [18] and Singhamuni *et al.* (2015) [19] evaluated the performance of *Trichogramma chilonis* under the exposure of insecticide like neem (2%) and (7%) and recorded 59.3 and 51.5 percent level of parasitism respectively which is slightly lower to our findings. which may be because of possible deterancy or repellent effect of the particular product used.

In present study chlorantraniliprole was also found as next harmless compound after azadirachtin for *T. chilonis*, based on the percent decrease in parasitization over control where 64 percent parasitization was recorded. Madhu Sudhanan *et al.* (2014) [20] recorded 75.86 percent parasitization by *T. chilonis* when exposed to chlorantraniliprole, which was relatively higher as compared to our findings. chlorantraniliprole on adults of *T. chilonis* and evaluated chlorantraniliprole as relatively compatible with the parasitism by the minute parasitoids and can be integrated with the minute parasitoid in agro ecosystem which is in agreement of our findings.

Azadirachtin and chlorantraniliprole were found as moderately safer to *T. chilonis* followed by flubendiamide, profenofos, spiromesifen and buprofezin. Anoop and Singh (2012) [21] reported that profenofos caused adverse effect on reduction in percent parasitization of *T. chilonis* on the *C. cephalonica* host eggs and according to IOBC it is classified under moderately harmful compound which is in agreement to our findings. Madhu Sudhanan *et al.* (2014) [20] tested the impact of flubendiamide and recorded 80-84 percent parasitization by *T. chilonis*, which was relatively on higher side compared to present study. Khan *et al.* (2015) [23] observed that spiromesifen was slightly harmful for parasitism by the female *T. chilonis*, exposed to the

previously treated host eggs of *S. cereallella*. Thus, these results are in line with our findings. Nasreen *et al.* (2004) [22] tested the toxicity of buprofezin against egg parasitoid *T. chilonis*. The results revealed that parasitism rate of *T. chilonis* was highest 100 percent in buprofezin, which was relatively on higher side compared to present study. Singhamuni *et al.* (2015) [19] evaluated the performance of *Trichogramma chilonis* under the exposure of insecticide profenofos and recorded 48.00 percent parasitization which is just near to our findings and classified as moderately harmful compound which is also in agreement to our findings.

Table 1: Effect of newer insecticides on extent of egg parasitization of *C. cephalonica* by *T. chilonis*

Tr. No.	Treatment details	Conc. (%)	(%) Egg parasitization of *C. cephalonica*				Percent reduction in parasitization over control	Toxicity Score
			R1	R2	R3	Mean		
T_1	Chlorantraniliprole 18.5 SC	0.005%	62 (51.94)	66 (54.33)	64 (53.13)	64.00 (53.13)	26.14	Harmless
T_2	Profenofos 50 EC	0.005%	48 (43.85)	46 (42.70)	54 (47.29)	49.33 (44.61)	43.07	Slightly harmful
T_3	Cartap Hydrochloride 50 SP	0.1%	8 (16.42)	10 (18.43)	6 (14.17)	8.00 (16.34)	90.76	Moderately harmful
T_4	Spiromesifen 22.9 SC	0.006%	46 (42.70)	40 (39.23)	48 (43.85)	44.66 (41.93)	48.45	Slightly harmful
T_5	Buprofezin 25 SC	0.005%	36 (36.86)	38 (38.05)	32 (34.44)	35.33 (36.45)	59.22	Slightly harmful
T_6	Flubendiamide 20% WG	0.01%	56 (48.44)	60 (50.76)	64 (53.13)	60.00 (50.78)	30.76	Slightly harmful
T_7	Azadirachtin 1500 ppm	0.005%	68 (55.55)	66 (54.33)	66 (54.33)	66.66 (54.73)	23.06	Harmless
T_8	Lambda cyhalothrin 9.5% + Thiamethoxam 12.6% ZC	0.002%	14 (21.97)	8 (16.42)	10 (18.43)	10.66 (18.94)	87.68	Moderately harmful
T_9	Control	Water spray	90 (71.56)	86 (68.02)	84 (66.42)	86.66 (68.67)	0.00	-
	F test					Sig		
	SE(m)					1.24		
	CD @5%					3.71		

Fig in parentheses are arc sin transformed value

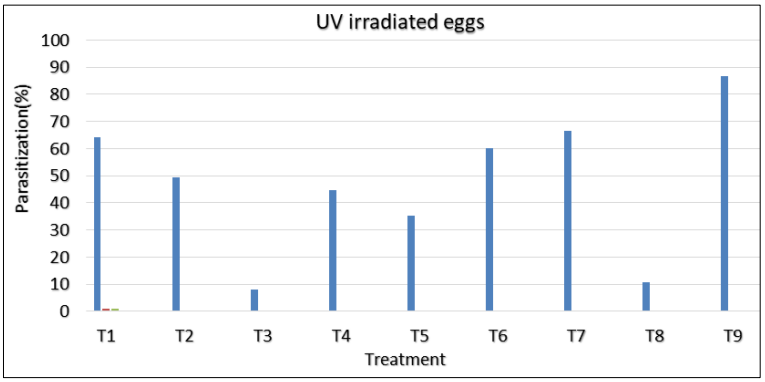

Fig 1: Effect of newer insecticides on extent of egg parasitization of *C. cephalonica* by *T. chilonis*

Conclusions

Azadirachtin, a neem based botanical insecticide was found most safer compound for host egg ultimately for *T. chilonis* than other insecticides. Thus, azadirachtin can be safely used along with *T. chilonis* for effective management of lepidopteran insect pest in agro ecosystem.

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