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Nihal P Kokode
Post Graduate Student, College of Agriculture, Nagpur, Dr. PDKV, Akola, Maharashtra, India

Dr. HR Sawai
Assistant Professor, College of Agriculture, Nagpur, Dr. PDKV, Akola, Maharashtra, India

Pragati R Jawake
Post Graduate Student, College of Agriculture, Nagpur, Dr. PDKV, Akola, Maharashtra, India

Akshay S Shinde
Post Graduate Student, College of Agriculture, Nagpur, Dr. PDKV, Akola, Maharashtra, India

Corresponding Author:
Pragati R Jawake
Post Graduate Student, College of Agriculture, Nagpur, Dr. PDKV, Akola, Maharashtra, India

Evaluation of residual toxicity of newer insecticides against efficiency of *Trichogramma chilonis*

Nihal P Kokode, Dr. HR Sawai, Pragati R Jawake and Akshay S Shinde

Abstract
Investigations were carried out to assess the toxicity of certain 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 various biological parameters of *Trichogramma chilonis* Ishii. To test the toxicity of these pesticides on the adult mortality of *T. chilonis* in the fictitious host eggs of *Corcyra cephalonica* Stainton, bioassay investigations were conducted in a laboratory environment. Result observed that the least mortality in increasing order of residual toxicity of insecticides were, Azadirachtin 1500 ppm < chlorantraniliprole 18.5 SC ≤ flubendiamide 20% WG < profenofos 50 EC < spiromesifen 22.9 SC < buprofezin 25 SC < lambda cyhalothrin 9.5% + Thiamethoxam 12.6% ZC < cartap hydrochloride 50 SP adult per cent mortality observed 25.33, 40.00, 44.00, 50.66, 52.00, 54.66, 86.66 and 100.00 respectively at 1st day after treatment. However, at 5th day the residual effect of various test insecticides with 20.00, 30.66, 30.66, 36.00, 38.66, 42.66, 73.33 and 93.33 adult per cent mortality respectively whereas at 10th day the residual toxicity of an insecticides on adult mortality recorded with 13.33, 14.66, 17.33, 20.00, 20.00, 30.66, 58.66 and 78.66 per cent respectively. All of the insecticides used in the current experiment were classified by the IOBC as slightly persistent to all of the insecticides that demonstrated toxicity to varying degrees up to 10 days.

Keywords: Adult mortality, *Trichogramma chilonis*, *Corcyra cephalonica*

Introduction

2000 years ago, biological control has been started for insect pest management but from nineteenth century modern use has been followed. (De Bach 1964 and van Lenteren and Godfray 2005) [6, 21]. The knowledge on impacts of pesticides, lethal and sublethal effects is necessary for an effective integration of chemical and biological control measures (Stapel *et al.* 2000; Ruberson *et al.* 1998; Stark *et al.* 2007; Croft 1990) [17, 15, 18, 5] which reduces the usage of insecticides as well as resistance to insecticide (Gardner *et al.* 2011) delayed by conserving effective beneficial arthropods (Gentz *et al.* 2010; Gould *et al.* 1991) [9-10]. Integrated pest management requires use of selective pesticides which are harmful to natural enemies (Leite *et al.* 2017) [13]. Susceptibility to pesticides higher in immature stages as they are protected inside the host eggs whereas the adult parasitoids are more exposed to pesticide residues comparatively (Suh *et al.* 2000; Bull and Coleman 1985; Bull and House 1983 and Ruberson 2017; Consoli *et al.* 1998) [19, 1, 2, 12, 4]. The release time of natural enemies and spraying frequency planning are the strategies in insect pest management which are required to determine the control of insecticide by determining its residual period. The evaluation of the residual and toxic effects of insecticides is important for the successful integration of biological and chemical control (Kang *et al.* 2018) [11]. Now a days high pesticide residues in food, pest resistance and resurgence, killing of non target organisms and ill effects on health of human, food chain toxicity to natural enemies like Predators and Parasitoid (Paroda, 2001) [14]. In India usage of pesticide is about 80-90 per cent on vegetables, several commercial crops and stored grain. In Integrated pest management programme we should consider the role of pesticides in order to overcome the problems in pest alarming situation. The role of biological control agents is very important with good attributes for pest management (Chopra, 2001) [3]. One of the important biological control agents are the Trichogrammatidae egg parasitoids against lepidopteron pests by inundative release. The combined safe and sustainable use of chemical and biological control are important in IPM. Hence the present study was conducted to estimate the effects of residual toxicity of newer insecticides against the egg parasitoid *T. chilonis.*

Material and Method
At the College of Agriculture Nagpur's Bio control Laboratory, a study on the residual toxicity of more modern insecticides against the egg parasitoid *T. chilonis* was conducted. A completely randomized experimental design was used to carry out the studies, with nine different treatments being replicated three times.

Culturing of *Trichogramma chilonis*
An experiment was run to determine the parasitoid's ideal storage temperature and time period. *T. chilonis* nucleus culture was obtained from the Biocontrol lab College of Agriculture, Nagpur. In a lab environment, an experiment was conducted to examine the residual effects of pesticides on adult parasitoids. By using the glass vial bioassay method, the impact of pesticide residues on adult *Trichogramma chilonis* survival was investigated. Glass vials measuring approximately 15 by 4 cm were used for this. A sufficient amount of insecticidal solution was made in acetone at the recommended concentration for each pesticide. By adding 1 cc of spray liquid to each vial and immediately rotating by hand, a thin uniform film of each insecticide was applied to each vial, coating it evenly. As a control, a batch of glass vials treated with acetone was retained. In order to examine the residual toxicity of the insecticides, 20–25 newly emerging adults of *Trichogramma chilonis* were introduced into each vial at intervals of the first, fifth, and tenth days following treatment. The number of dead and living adults was observed after the adults were exposed to insecticide residues for 4 hours.

Statistical analysis
Data recorded during present study on residual toxicity against *T. chilonis* adult mortality were statistically analyzed by using OPSTAT software which is available online on Hissar Agricultural University, Hissar

Results and Discussion
Residual toxicity effect of newer insecticides against *Trichogramma chilonis* adults (1st, 5th and 10th day after treatment)
The findings on the mortality of *T. chilonis* adults exposed to the residues of different test insecticides after the first, fifth, and tenth days following treatment to the vials is reported in Table 1 and shown in Fig. 1. The results after 1st day of treatment revealed that the treatment of azadirachtin only with 25.33 per cent adult mortality found significantly superior to the adult parasitoids as compare to control with 0.00 per cent. However significantly superior with 20.00 per cent least adult mortality over other insecticides after 5th day of treatment. The results observed nil mortality of *T. chilonis* adults in control treatment. However, after 10 days of treatment azadirachtin had the lowest amount of residual toxicity to adults of *T. chilonis*, with 13.33 percent. The treatment cartap hydrochloride highest mortality recorded 100, 93.33 and 78.66 per cent at first, fifth, and tenth days after treatment respectively. Residual toxicity of different insecticides exposed during 1st, 5th and 10th day of bioassay treatment were depicted in Fig. 1. recorded almost same order of toxicity during all the three test periods with progressive decrease in adult mortality from 1st to 10th days of treatment.

Similar work carried out by earlier workers are in agreement with our present investigation. Fand *et al.* (2009) [7] recorded residual toxicity of newer insecticides neem oil after 1,5 and 10 days of treatment adult mortality was observed 45.33, 25.33, and 17.33 per cent respectively. This data also shows a gradual decline in adult mortality over time, which is consistent with our current findings. Azadirachtin, a botanical insecticide, was shown to be harmless to *T. chilonis* in terms of residual toxicity, according to results on residual toxicity. It had a substantially lower residual problem than chemical insecticides. In contrast to our findings, Sabry *et al.* (2014) [16] evaluation of the residual effects of chlorantraniliprole and thiamethoxam in *Trichogramma evanescens* revealed thiamethoxam to be less harmful than chlorantraniliprole against natural enemies. Buprofezin and chlorantraniliprole were classified as "harmless" by Uma *et al*. (2014) based on the IOBC safety classification, while thiamethoxam and flubendiamide were shown to be just marginally hazardous to *Trichogramma japonicum*. All of the pesticides used in this experiment were classified as slightly persistent by the IOBC due to the fact that they all shown toxicity ranging from a minor to a major level up to 10 days.

Table 1: Residual toxicity effect of newer insecticides against *Trichogramma chilonis* adults

Tr. No.	Treatment details	Conc. (%)	Mean of Adult mortality (%)		
			1st day after treatment	5th day after treatment	10th day after treatment
T_1	Chlorantraniliprole 18.5 SC	0.005%	40.00 (39.21)	30.66 (33.58)	17.33 (24.57)
T_2	Profenofos 50 EC	0.005%	50.66 (45.38)	36.00 (36.85)	20.00 (26.49)
T_3	Cartap Hydrochloride 50 SP	0.1%	100.00 (90.00)	93.33 (75.20)	78.66 (62.58)
T_4	Spiromesifen 22.9 SC	0.006%	44.00 (41.54)	38.66 (38.43)	20.00 (26.49)
T_5	Buprofezin 25 SC	0.005%	52.00 (46.14)	42.66 (40.77)	30.66 (33.55)
T_6	Flubendiamide 20% WG	0.01%	54.66 (47.67)	30.66 (33.58)	14.66 (22.36)
T_7	Azadirachtin 1500 ppm	0.005%	25.33 (30.11)	20.00 (26.49)	13.33 (21.37)
T_8	Lambda cyhalothrin 9.5% + Thiamethoxam 12.6% ZC	0.002%	86.66 (68.80)	73.33 (59.01)	58.66 (49.99)
T_9	Control	Water spray	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	F test		Sig	Sig	Sig
	SE(m)		1.52	1.53	1.54
	CD @ 5%		4.57	4.58	4.61

*Fig in parentheses are arc sin transformed value

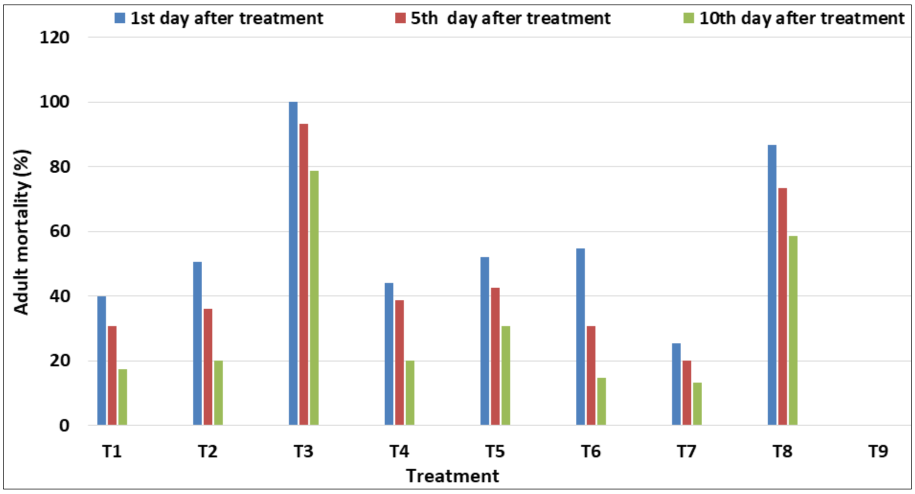

Fig 1: Effect of residual toxicity of newer insecticides against *Trichogramma chilonis* adults

Conclusions

Azadirachtin, a neem based botanical insecticide was found most safer compound after control during the adult emergence from pupal stage, less residual toxicity against *T. chilonis*, than other insecticides. Thus, azadirachtin can be safely used along with *T. chilonis* for effective management of lepidopteran insect pest in agroecosystem. Chlorantraniliprole, a carboxamide compound found slightly harmful effects in case of residual toxicity.

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