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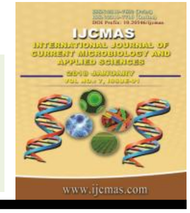

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Relative Toxicity of Commonly Used Insecticides and Combination Products in Cotton Ecosystem to *Chrysoperla zastrowi sillemi* (Esben–Peterson) under Laboratory Condition

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A B S T R A C T

The relative toxicity of ten insecticides and three ready to use combination products, used for cotton insect pest management were assessed against the green lace wing, *Chrysoperla zastrowi sillemi* (Esben-Peterson) in the laboratory, Department of Agricultural Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari during 2014. Amongst tested insecticides, buprofezin 25 SC @ 0.05% and fipronil 5 SC @ 0.02% were categorized as slightly harmful; clothianidin 50 WP @ 0.005%, diafenthiuron 50 WP @ 0.06%, imidacloprid 70 WG @ 0.005% and flonicamid 50 WDG @ 0.015% as moderately harmful and bifenthrin 10 EC @ 0.016%, lamda-cyhalothrin 5 EC @ 0.005%, methyl parathion 50 EC @ 0.1%, thiacloprid 21.7 SC @ 0.03%, chloropyriphos 50% + cypermethrin 5% EC @ 0.11, acephate 50% + imidachloprid 1.8% SP @ 0.103% and deltamethrin 1% + triazophos 35% EC @ 0.092% as harmful insecticides to the second instars larvae of *C. zastrowi sillemi* when assessed through thin film technique. While assessing relative toxicity through food contamination technique against the adults of *C. zastrowi sillemi*, buprofezin 25 SC @ 0.05% was categorized as harmless; bifenthrin 10 EC @ 0.016%, clothianidin 50 WP @ 0.005%, diafenthiuron 50 WP @ 0.06%, fipronil 5 SC @ 0.02%, imidacloprid 70 WG @ 0.005%, flonicamid 50 WDG @ 0.015% and thiacloprid 21.7 SC @ 0.03% as slightly harmful; lamda-cyhalothrin 5 EC @ 0.005%, acephate 50% + imidachloprid 1.8% SP @0.103% and chloropyriphos 50% + cypermethrin 5% EC @ 0.11% as moderately harmful and methyl parathion 50 EC @ 0.1% and deltamethrin 1% + triazophos 35% EC @ 0.092% as harmful insecticides.

Introduction

Cotton is still one of the chemical intensive crops and insect pest is the limiting factor for the successful cultivation of this crop. Change in pest dynamics has become more common in recent times owing to changing cropping systems and environment with the dominance of Bt cotton across India. In the Bt era, cotton bollworms have drastically reduced while sucking pest have emerged as key and major pests. Their heavy infestation at times reduces the crop yield to a great extent. Due to growing environmental and economic concerns involved in the use of pesticides, the concept of IPM is an integral part for pest management in any crop. Pesticides lead to many serious problems like pollution, health hazards, biodiversity threat, pest resurgence, pest resistance and secondary pest out-breaks in ecosystem (Bellows, 2001).

Biological control is an effective means of achieving insect control (Pedigo and Rice, 2000). In cotton ecosystem, the common green lacewing, *Chrysoperla carnea* (Stephens) has been recorded as an effective predator of sucking pests including aphids, thrips, mites (Burke and Martin, 1956; Yuksel and Gocmen, 1992; Balasubramani and Swamiappan, 1994; Zaki *et al.*, 1999) and has potential against cotton mealy bug (Sattar *et al.*, 2007; Tanwar *et al.*, 2007; Gautam *et al.*, 2010; Ram and Saini, 2010; Rashid *et al.*, 2012; Hameed *et al.*, 2013), especially under pesticides free environment. The green lacewing, *Chrysoperla zastrowi sillemi* (Esben-Peterson) in the field preferred to oviposit on cotton followed by okra and it laid eggs on stalks on lower surface of leaves for oviposition followed by stem (Chakraborty *et al.*, 2011).

The common green lacewing, *C. zastrowi sillemi* seems to be a good candidate in IPM programme, as it is a voracious feeder (Balasubramani and Swamiappan, 1994), display a relative broad range of acceptable preys (Hydron and Whitecomb, 1979), easy to mass produced (Morrison, 1985 and El-Arnaouty, 1991) and is tolerant to some groups of pesticides (Hassan *et al.*, 1985; Bigler and Waldburger, 1994; Chen and Liu, 2002). The occurrence of *C. zastrowi sillemi* along with its prey insects in cotton ecosystem of Gujarat necessities to develop a sound pest management programme, the knowledge on the safety and adverse effect of pesticides to promising green lace wing is essential. So there is need to study relative toxicity of different insecticides used commonly in cotton ecosystem against larvae and adult stages of *C. zastrowi sillemi* under laboratory condition to find out suitable insecticides less hazardous to predator.

Materials and Methods

Ten insecticides and three ready to use combination products were assessed for their relative susceptibility to larvae and adult stages of *C. zastrowi sillemi* in the laboratory, Department of Agricultural Entomology, N.M. College of Agriculture, Navsari Agriculture University, Navsari in December 2014.

Maintenance of *Chrysoperla* culture

The laboratory culture of *C. zastrowi sillemi* was obtained from *Chrysoperla* Rearing Unit, Bio-control Laboratory, Department of Agricultural Entomology, N.A.U., Navsari. The pupae of *C. zastrowi sillemi* were placed in glass vial separately for adult emergence. Freshly emerged adults were released in rectangular oviposition cage of size 50 × 30 × 17 cm (Length x Width x Height) covered with a black muslin cloth inside the lid of the cage to facilitate egg laying. Semi solid paste of artificial diet (composed of 4 g of each ingredients of honey, proteinex powder, glucose, fructose, yeast powder, milk powder in equal quantity of distilled water with dispersible vitamin E capsule along with castor pollens) were placed on cotton swab in small plastic container at inside of the bottom of the oviposition cage for nutrition of adults. Eggs laid by the female on the under surface of lid of the cage on black muslin cloth which were removed individually with the help of a soft sponge pad for removing the stalk of eggs and kept individually with the help of fine camel hair brush and placed in separate plastic vials (5 x 2.5 cm) for further rearing and to avoid cannibalism. A special care was also taken to avoid mechanical injury to the eggs during detaching it from the stalk. On hatching, the larval instar of *Chrysoperla* was reared on laboratory host (eggs of rice grain moth, *Corcyra cephalonica* (Stainton) till pupae formation and again the eggs were collected as described above. The culture was maintained during the study period at an average room temperature of 24.03 ± 1.75 °C and relative humidity of 73.08 ± 2.86 per cent. Neonate larvae of *C. zastrowi sillemi* obtained through mass rearing as above were utilized for the study.

Assessment of relative toxicity to larvae and adults of *C. zastrowi sillemi*

Formulated products of ten insecticides *viz*., buprofezin 25 SC, diafenthiuron 50 WP, imidacloprid 70 WG, clothianidin 50 WDG, bifenthrin 10 EC, lamda-cyhalothrin 5 EC, methyl Parathion 50 EC, flonicamid 50 WG, thiacloprid 21.7 SC and fipronil 5 SC and three combination products *viz*., acephate 50 % + imidacloprid 1.8 SP, chlorpyriphos 50 % + cypermethrin 5% and deltamethrin 1%+ triazophos 35% EC along with control (water spray) were assessed to determine their relative toxicity against second instar larvae of *C. zastrowi sillemi*. The relative toxicity of insecticide was tested by using the thin film method (Anon., 1994). For preparing insecticide film, plastic vials (5x2.5 cm) were treated by dipping them in respective insecticide solutions, followed by drying under fan for 15 minutes. Twenty second instar larvae of *C. zastrowi sillemi* were released into the treated plastic vials in each treatment and were allowed to remain in contact with insecticide film for 45 minutes. Thereafter, larvae were transferred individually to fresh plastic vials (5x2.5 cm) containing Corcyra eggs that served as food. The observation on larval mortality was recorded at 12, 24, 48 and 72 hours after exposure to insecticide treatments. The moribund larvae were also considered as dead. The per cent corrected mortality was calculated by using Abbott's formula. Effect of insecticides was expressed as mortality of second instar larvae. The data on per cent corrected mortality so obtained were subjected to statistical analysis adopting CRD design after arc-sine transformation.

The relative toxicity of above insecticides was also tested against adult (2-days old) stage of *C. zastrowi sillemi* with poison food technique as adopted by Rezaei *et al.*, (2006) and Sabry and EL-Sayed (2011) while studying the biosafety of *C carnea* to pesticides. Twenty healthy adults of *C. zastrowi sillemi* were released in each glass jar (20 × 12 cm) covered with muslin cloth tied in position with rubber band for one repetition. These adults in all repetition were fed on 10 per cent sugar solution contaminated with tested concentration of insecticides under study. In the control treatment, the adults were fed only with 10 per cent sugar solution. All cages were incubated at room temperature and inspected after 24 hour and the number of adults died was recorded in each treatment and repetition. The corrected mortality of adults in each treatment was estimated as described above. The safety of tested insecticides was categorized as per the rating of IOBC/WPRS (Hassan, 1989).

Results and Discussion

Relative toxicity to larvae of *C. zastrowi sillemi*

The cumulative mortality of larvae of *C. zastrowi sillemi* recorded at 12, 24, 48 and 72 hours after exposure of larvae (2nd instar) as indicated that there was significant difference in mortality of larvae of *C. zastrowi sillemi* (second instar) in different insecticide treatments during different periods. At 12 hour after exposure, the lowest mortality was found in treatments of buprofezin 25 SC@ 0.05% and fipronil 5 SC @ 0.02% (0.00 %) and both the treatments were found significantly superior to rest of the treatments under study. The next group of effective insecticides were imidachloprid 70 WG @ 0.005%, diafenthuaron 50 WP @ 0.06%, flonicamid 50 WDG @ 0.015%, clothianidin 50 WP @ 0.005%, lamda-cyhalothrin 5 EC @0.005%, deltamethrin 1% + triazophos 35% EC @ 0.092%, bifenthrin 10 EC @ 0.016 % and thiacloprid21.7 SC @ 0.03 % registered 7.50 to 20.00 per cent mortality and were equally effective. Readymade combination product of acephate 50% + imidacloprid 1.8 % SP @0.103% recorded highest mortality (37.50 %) and was statistically at par with the treatments of methyl parathion 50 EC@0.1%, chlorpyrifos 50 %+ cypermethrin 5 % EC @ 0.115 % and thiacloprid 21.7 SC @ 0.03 % (20 to 37.50 % mortality). Similarly at 24 hour after exposure, the lowest mortality was recorded in buprofezin 25 SC (15 %) and was statistically at par with fipronil 5 SC (22.50 % mortality). The later insecticide, on the other hand, was also remained statistically at par with imidacloprid 70 WG, clothianidin 50 WP, diafenthuaron50 WP and flonicamid 50 WDG recording 42.50 to 47.50 per cent mortality. methyl parathion 50 EC recorded the highest mortality (cent per cent) and was found statistically at par with chlorpyrifos 50 % + cypermethrin 5 % EC (62.50 %).

At 48 hours after exposure, the lowest mortality (30 %) was found in fipronil 5 SC (30.00 %) followed by buprofezin 25 SC (42.50%) and both the insecticides were significantly superior to rest of the treatments. The highest mortality was found in methyl parathion 50 EC and chlorpyrifos 50 %+cypermethrin 5 % EC (cent per cent) and both insecticides were significantly inferior to rest of the treatments. The intermediate group of insecticides were flonicamid 50 WDG, imidacloprid 70 WG, lamda-cyhalothrin 5 EC, bifenthrin 10 EC, biafenthiuron 50 WP, acephate 50% + imidacloprid 1.8 % SP and thiacloprid 21.7 SC (70.00 to 87.50 % mortality). At 72 hour after exposure, the lowest mortality was recorded in fipronil 5 SC (60.00 %) which was statistically at par with buprofezin 50 WDG (65.00 %) and flonicamid 50 WDG (80.00 % mortality) and was significantly superior to rest of the treatments under study. The treatments of bifenthrin 10 EC, lamda-cyhalothrin 5 EC, methyl parathion 50 EC, chloropyrifos 50% + cypermethrin 5% EC, acephate 50%+imidachloprid 1.8% SP, deltamethrin 1%+triazophos 35% EC and thiacloprid 21.7 SC recorded highest mortality (100.00 %). The insecticidal effect (% cumulative mortality after 72 hour) on larvae of *C. zastrowi sillemi* were also categorized and interpreted as per the recommendations of International Organization for Biological Control, West Palearctic Regional Section (IOBC/WPRS) working group suggested by Hassan (1989) when tested at field recommended dose.

Amongst tested insecticides, buprofezin 25 SC and fipronil 5 SC were categorized as slightly harmful; clothianidin 50 WP, diafenthiuron 50 WP, imidacloprid 70 WG and flonicamid 50 WDG as moderately harmful and bifenthrin 10 EC, lamda-cyhalothrin 5 EC, methyl parathion 50 EC, thiacloprid 21.7 SC, chloropyrifos 50%+cypermethrin 5% EC, acephate 50% + imidachloprid 1.8% SP and deltamethrin 1%+triazophos 35% EC as harmful insecticides against the larvae of *C. zastrowi sillemi*.

Relative toxicity to adults of *C. zastrowi sillemi*

The mortality of adults (2-days old) of *C. zastrowi sillemi* recorded at 24 hour after exposure (food contamination technique) indicated the lowest mortality of adult in buprofezin 25 SC (37.50 %) which was statistically at par with flonicamid 50 WDG, diafenthiuron 50 WP, imidacloprid 70 WG, fipronil 5 SC, thiacloprid 21.7 SC and clothianidin 50 WDG (52. 50 to 60.00 % mortality).

Table.1 Insecticides used for relative toxicity against *C. zastrowi sillemi* under laboratory

Sr. No	Insecticide (Common and Trade name)	Conc. (%)	Chemical name (IUPAC name)	MoA Classification Group
1	Bifenthrin 10 EC (Talstar)	0.016	2-Methyl-3-phenylphenyl)methyl (1*S*,3*S*)-3-[(*Z*)-2-chloro-3,3,3-trifluoroprop-1-enyl]- 2,2-dimethylcyclopropane-1-carboxylate	Pyrethroids (3A) Sodium channel modulators
2	Buprofezin 25 SC (Applaud)	0.05	(Z)-2- tert - butylimino - 3 - isopropyl – 5-phenyl-1,3,5 – thiadiazinan- 4- one	IGR (16) Inhibitors of chitin biosynthesis, type 1
3	Clothianidin 50 WDG (Dantotsu)	0.005	(*E*)-1-(2Chloro5thiazolylmethyl) 3-methyl2nitroguanidine	Neonicotinoids (4A) Nicotinic acetylcholine receptor (nAChR) Agonists
4	Diafenthiuron 50 WP (Polo)	0.06	*N*-[2,6bis(1methylethyl) 4-phenoxyphenyl] *N'*- (1,1dimethylethyl) thiourea	Thio-urea (12A) Inhibitors of mitochondrial ATP synthase
5	Fipronil 5 SC (Regent)	0.02	(*RS*)-5-amino-1-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-(trifluoromethylsulfinyl)-1H-pyrazole-3-carbonitrile	Phenylpyrazoles (2B) GABA-gated chloride channel antagonists
6	Imidacloprid 70 WG (Admire)	0.005	*N*-{1-[(6-Chloro-3-pyridyl)methyl]-4,5-dihydroimidazol-2-yl}nitramide	Neonicotinoids (4A) Nicotinic acetylcholine receptor (nAChR) Agonists
7	Lamda-cyhalothrin 5EC (Karate)	0.005	(RS)alphacyano-3-phenoxybenzyl 3-(2-chloro-3,3,3-trifluoropropenyl)- 2,2, Dimethylcyclopropanecarboxylate	Pyrethroids (3A) Sodium channel modulators
8	Methyl Parathion 50EC (Folidon)	0.1	Dimethoxy (4nitrophenoxy) Sulfanylidene {5}-phosphane	Organophosphates(1B) Acetylcholinesterase (AChE) inhibitors
9	Flonicamid 50WDG (Ulala)	0.015	IKI-220; N-cyanomethyl-4 trifluoromethylnicotinamide	Pyridial(9C) Modulators of Chordotonal Organs
10	Thiacloprid 21.7 SC (Splendor)	0.03	{(2Z)-3-[(6-chloropyridin-3-yl)méthyl]-1,3-thiazolidin-2-ylidène}cyanamide	Neonicotinoids(4A) Nicotinic acetylcholine receptor (nAChR) Agonists
11	Acephate 50 % +Imidacloprid 1.8 SP (Lancer gold)	0.103	N -(Methoxymethylsulfanylphosphoryl) acetamide + N-{1-[(6-Chloro-3-pyridyl)methyl]-4,5-dihydroimidazol-2-yl}nitramide	Organophosphates(1B) + Neonicotinoids(4A)
12	Chloropyrifos 50 %+Cypermethrin 5 % EC (Durmet D 505)	0.11	O,O Diethyl O 3,5,6-trichloropyridin2yl Phosphorothioate + [Cyano- (3 phenoxyphenyl)methyl]3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropane-1-carboxylate	Organophosphates(1B) + Pyrethroids(3A)
13	Deltamethrin 1 %+ Triazophos 35 % EC (Spark)	0.092	[(S)-Cyano-(3-phenoxyphenyl)-methyl] (1R,3R)-3-(2,2-dibromoethenyl)-2,2-dimethyl-cyclopropane-1-carboxylate + O, O- diethyl O- (1- Phenyl - 1 H - 1,2,4- triazol - 3 yl) Phosphorothioate	

Table.2 Relative toxicity of *C. zastrowi sillemi* to different pesticides under laboratory condition

Tr.	Insecticidal treatments	Per cent mortality of *C. zastrowi sillemi* hour after exposure									
		Larvae								Adult	
		12 hour		24 hour		48 hour		72 hour		24 hour	
T_1	Bifenthrin 10 EC	22.77	(15.00)	46.42	(52.50)	67.47	(85.00)	89.67	(100.00)	55.36	(67.50)
T_2	Buprofezin 50 WDG	0.29	(0.00)	22.78	(15.00)	40.66	(42.50)	53.70	(65.00)	37.66	(37.50)
T_3	Clothianidin 50 WP	17.85	(10.00)	42.10	(45.00)	80.60	(95.00)	80.60	(95.00)	50.78	(60.00)
T_4	Diafenthiuron 50 WP	15.67	(7.50)	43.53	(47.50)	67.47	(85.00)	78.43	(92.50)	47.87	(55.00)
T_5	Fipronil 5 SC	0.29	(0.00)	27.99	(22.50)	32.88	(30.00)	50.87	(60.00)	49.29	(57.50)
T_6	Imidachloprid 70 WG	15.67	(7.50)	40.66	(42.50)	59.97	(75.00)	70.22	(87.50)	47.87	(55.00)
T_7	Lamda-Cyhalothrin 5 EC	22.49	(15.00)	53.20	(62.50)	60.09	(75.00)	89.67	(100.00)	65.76	(82.50)
T_8	Methyl parathion 50 EC	37.48	(37.50)	89.67	(100.00)	89.67	(100.00)	89.67	(100.00)	89.68	(100.00)
T_9	Flonicamid 50 WDG	17.84	(10.00)	43.53	(47.50)	57.08	(70.00)	65.37	(80.00)	46.43	(52.50)
T_{10}	Thiacloprid 21.7 SC	26.38	(20.00)	46.41	(52.50)	69.36	(87.50)	89.68	(100.00)	49.34	(57.50)
T_{11}	Acephate 50% + Imidachloprid 1.8% SP	37.66	(37.50)	56.84	(70.00)	67.18	(85.00)	89.68	(100.00)	65.76	(82.50)
T_{12}	Chloropyrifos 50% + cypermethrin 5% EC	33.20	(30.00)	64.15	(80.00)	89.67	(100.00)	89.68	(100.00)	80.61	(95.00)
T_{13}	Deltamethrin 1% + Triazophos 35% EC	22.49	(15.00)	57.07	(70.00)	74.29	(92.50)	89.68	(100.00)	89.68	(100.00)
	G.M.	20.78	--	48.80	--	65.88	--	79.00	--	59.70	--
	S Em $\pm$	3.78	--	5.40	--	4.12	--	5.73	--	4.43	--
	C.D. at 0.5%	11.55	--	16.49	--	12.59	--	17.49	--	13.53	--
	C.V. %	25.74	--	15.65	--	8.85	--	10.25	--	10.50	--

Note: Figures in the parenthesis are original value, those outside are the arc-sine transformed mean

Table.3 Susceptibility of larvae and adult of *C. zastrowi sillemi* to insecticides based on initial evaluation test in laboratory at recommended dose

Sr. No.	Insecticides	Conc. (%)	Insecticides category* based on relative toxicity to *C. zastrowi sillemi* (hour after exposure)		
			Larvae (second instar)		Adults (2-day old)
			(48 H)	(72 H)	(24 H)
T_1	Bifenthrin 10 EC	0.016	3	4	2
T_2	Buprofezin 50 WDG	0.05	1	2	1
T_3	Clothianidin 50 WP	0.005	3	3	2
T_4	Diafenthiuron 50 WP	0.06	3	3	2
T_5	Fipronil 5 SC	0.02	1	2	2
T_6	Imidachloprid 70 WG	0.005	2	3	2
T_7	Lamda-Cyhalothrin 5 EC	0.005	2	4	3
T_8	Methyl parathion 50 EC	0.1	4	4	4
T_9	Flonicamid 50 WDG	0.015	2	3	2
T_{10}	Thiacloprid 21.7 SC	0.03	3	4	2
T_{11}	Acephate 50% + Imidachloprid 1.8% SP	0.103	3	4	3
T_{12}	Chlorpyriphos 50% + cypermethrin 5% EC	0.11	4	4	3
T_{13}	Deltamethrin 1% + Triazophos 35% EC	0.092	3	4	4

Note:

IOBC/WPRS rating		
No.	**Categories**	**Per cent mortality**
1	Harmless	<50
2	Slightly harmful	50 to 79
3	Moderately harmful	80 to 99
4	Harmful	>99
		Source: Hassan (1989)

The highest mortality (100%) was found in methyl parathion 50, deltamethrin 1%+triazophos 35 % EC and chlorpyifos 50%+cypermethrin 5 % and was significantly inferior to rest of the insecticide treatments.

The tested insecticides were also categorized as for their safety based on the IOBC method revealed that buprofezin 25 SC was categorized as harmless; bifenthrin 10 EC, clothianidin 50 WP, diafenthiuron 50 WP, fipronil 5 SC, imidacloprid 70 WG, flonicamid 50 WDG and thiacloprid 21.7 SC as slightly harmful; lamda-cyhalothrin 5 EC, acephate 50% + imidachloprid 1.8% SP and chloropyrifos 50%+cypermethrin 5% EC as moderately harmful and methyl parathion 50 EC and deltamethrin 1% + triazophos 35% EC as harmful insecticides against the adults of *C. zastrowi sillemi*.

In present study buprofezin 25 SC @ 0.05 % recorded 65.0 % mortality of second instar larvae of *C. zastrowi sillemi* at 72 hours after exposure and was categorized as slightly harmful whereas diafenthiuron 50 WP @ 0.06% as moderately harmful insecticide recording 92.50 % mortality. Earlier, Nasreen *et al.*, (2005) also reported that buprofezin 25 WP @0.531 % as slightly harmful and diafenthiuron 500 SC @ 0.5 % was harmful (48 hours after exposure) to first instar larvae of *C. carnea.* Sabry and El-Sayed (2011) also reported that buprofezin 25 SC was harmless to second instar larvae of *C. carnea*. In present study, imidacloprid 70 WG @0.005% was found moderately harmful whereas acephate 50 %+imidacloprid 1.8 % SP found as harmful combination product at 72 hours after exposure. Nasreen *et al.*, (2005) reported that imidacloprid 200 SL @ 0.178 as harmful insecticide to first instar larvae. In contrast to present finding, Preetha *et al.*, (2009) classified imidacloprid 17.8 SL and diafenthiuron 50 WP as harmless insecticides which caused< 50 per cent mortality of egg, larvae and adults of *C. carnea* at recommended dose. Rezaei *et al.*, (2006) found imidacloprid 35 SC as harmless to 2-day old larvae of *C. carnea*. This variation might be due to formulations and assaying techniques. Further in present study, bifenthrin 10 EC, lamda-cyhalothrin 5 EC, methyl parathion 50 EC, thiocloprid 21.7 SC and all three combination products (chloropyrifos 50% + cypermethrin 5% EC, acephate 50% + imidacloprid 1.8% SP and deltamethrin 1% + triazophos 35% EC) recorded 100 per cent mortality 72 hours after exposure and were found harmful to larvae of *C. zastrowi sillemi*. Vadodaria *et al.*, (2001) reported that combination products, Polytrin-C (profenofos 40 %+ cypermethrin 4% 44 EC) and Nurelle-D 505 (chlorpyrifos 50 % + cypermethrin 5% 55 EC) were toxic by recording 90 and 100 per cent mortality of larvae of *C. carnea*. Sabry and El-Sayed (2011) reported that lamda-cyhalothrin 2.5 EC was moderately harmful to second instar larvae of *C. carnea*. Amarasekare and Shearer (2013) stated that lamda-cyhalothrin @ 0.005% and Novaluron @ 0.04% were toxic to second instar larvae of both the species of *C. johnsoni* and *C. carnea*. In contrast to present findings, Lingren and Ridgway (1967) reported that methyl parathion was less toxic to larvae of chrysopid when treated topically or exposed to glass surface. This might be due to difference in formulation and assaying technique used (Table 1–3).

Further, in present study buprofezin 25 SC @ 0.05 % recorded 37.50 % mortality of 2-day old adults of *C. zastrowi sillemi* at 24 hours after exposure and was categorized as harmless insecticide to adult. Sabry and El-Sayed (2011) also reported that buprofezin 25 SC was harmless to adults of *C. carnea*. Imidacloprid 70 WG and diafenthiuron 50 WP were found slightly harmful to adults of *C. zastrowi sillemi* when exposed to poisoned food in present study. Katole and Patil (2000) reported that seed treatment of imidacloprid @ 8 g per kg of seed as safer treatment to adults of *C. carnea* than the foliar spray. Preetha *et al.,* (2009) classified imidacloprid 17.8 SL and diafenthiuron 50 WP as harmless insecticides which caused< 50 per cent mortality of adults of *C. carnea* at recommended dose. The present findings of lamda-cyhalothrin 5 EC as moderately harmful was more or less in confirmation with the report of Amarasekare and Shearer (2013) who stated that lamda-cyhalothrin@ 0.005% was toxic to adults of both the species of *C. johnsoni* and *C. carnea*.

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