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Safety influence of various tested insecticides against natural enemies i.e. *Chelonus blackburni* Cameron

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Abstract
Laboratory experiment was conducted at Bio-Control Unit, Division of Agril. Entomology, College of Agriculture, Pune during 2018-19, with a view to assess the safety of emamectin benzoate along with thiamethoxam and dimethoate to egg-larval parasitoid, *Chelonus blackburni* Cameron. The results revealed that emamectin benzoate at higher and lower doses tested significantly lesser adverse effect on adult mortality of *C. blackburni* compared to thiamethoxam and dimethoate. The higher (0.0011%) and lower (0.00055%) dose of emamectin benzoate tested was recorded 1.66, 3.33, 11.66 and 5.00, 11.66, 15.00 per cent adult mortality after 12, 24 and 48 hours amongst the tested insecticide. Whereas, thiamethoxam (0.005%) and dimethoate (0.06%) registered significantly highest mortality of 76.66 per cent and 100.00 per cent, respectively at 48 hours after treatment and indicated that dimethoate was observed extremely toxic and unsafe to *C. blackburni*.

Keywords: *Chelonus blackburni*, emamectin benzoate, thiamethoxam, dimethoate

Introduction
Chelonus blackburni Cameron is an important egg larval parasitoid of *Phthorimaea operculella* and other lepidopteran pests. Many insecticides used to control various insect pests in the field where was found to *C. blackburni* (Manisegaran and Kumarasamy, 1988) [4]. Preetha *et al.*, (2010) [7] studied the safety influence of different tested insecticides against natural enemies is an important practices to assess the toxicity before widely spread and usage of the chemical. These key natural enemies play an important role in suppressing insect pest populations under Integrated Pest Management. So therefore, it is necessary to conserve natural enemies present in the field. Natural enemies do not eliminate 100 per cent pest populations. Instead of these natural enemies establish equilibrium with insect pest populations that are generally below thresholds damage. When pest densities exceed these thresholds, an occasional insecticide treatment is needed. Thus, pesticide intervention is considered essential in some situations to control high infestations of specific pests so as to reduce economic damage and pest spread, to other crops. Selective insecticides that target pest species could play a role in conserving the wide diversity of natural enemies. Several insecticides that are widely used to suppress various pests can disrupt the effectiveness of the beneficial agents. It is less clear to what degree of insecticides are disruptive with other non-target organisms. Improved understanding of pest-natural enemy-insecticide interactions will assist in formulating more effective Integrated Pest Management strategies. Therefore, more recent evaluations on foliar insecticide, toxicity were recorded against selected natural enemies seem well-timed.

Materials and Methods
Experiments were conducted to test the toxicity of tested insecticides on *C. blackburni* at Bio-Control Unit, Division of Agil. Entomology, College of Agriculture, Pune-411 005 during 2018-2019. The experiments was done in completely randomized design with seven treatments and replicated three times. A dry film residue method was followed to assess the toxicity of tested insecticides against *C. blackburni*. Three different tested insecticides *i.e.* dimethoate, thiamethoxam and emamectin benzoate at higher and lower concentration solutions were prepared by using acetone and water in the ratio of 80:20 and used for calculating the toxicity against *C. blackburni*.

Glass vials of 30 ml capacity with an internal surface area of 50 cm^2 were used. The vials were cleaned by soaking overnight in soap water, rinsed with acetone and air-dried for at least 4 hours before use. The vials coated with 0.5ml of different concentrations of tested insecticides were dried thoroughly by rotating the vials on the table. For control, 0.5ml acetone: water (80:20) alone was used. Twenty freshly emerged adult from parasitized egg were released into the vial and covered with muslin cloth secured with rubber band. After 4 hour of exposure, the adult were placed in a clean and sterilized test tube and the mortality was recorded at 12, 24 and 48 hours after treatment (HAT). Each treatment was replicated three times for a total of 60 adult were released per treatment by Halappa, (2011) [1]. The statistical analysis of the data was carried out by using technique of analysis of variance and significance determined by Panse and Sukhatme, (1969). Summary tables for treatment effects have been prepared and presented with standard error of mean (S.Em ±) where as the result were significant, the critical difference (CD) was worked out at 5 per cent level of significance.

Results and Discussion

The data was indicated that emamectin benzoate (0.00055%) showed 1.66, 5.00, 11.66 per cent mortality followed by emamectin benzoate (0.0011%) was recorded adult mortality 3.33, 11.66, 15.00 per cent, respectively at 12, 24 and 48 hours which indicated that it was harmless to the adult *C. blackburni.* Emamectin benzoate have less persistency effect hence, it showed significantly less mortality. Effects were found in the laboratory by testing using 20 number of *C. blackburni*, but there were deficit of information on this line. But some studies on other species of non-target insect was found that emamectin benzoate was environmentally safe. In the present studies, the results showed more or less similarity with the observation recorded by Jasmine *et al.*, (2007) [3] reported that abamectin 1.9 EC @ 9 g a.i-ha^{-1} caused 0.0, 10.0 and 23.3 per cent mortality to *C. blackburni* at 12, 24 and 48 hours of treatments respectively. Govindan *et al*., (2013) [2] also revealed that emamectin benzoate 5 SG safer to coccinellids at all tested concentrations. Highest population was recorded in plots treated with emamectin benzoate 5 SG @ 7 g a.i-ha^{-1} followed by emamectin benzoate 5 SG at 11 g a.i-ha^{-1}.

Table 1: Influence of different tested insecticides at various concentrations on mortality of adult *C. blackburni* at 12 hours after treatment

Treatments	Concentration (%)	Dose in Aqueous Solution	Mortality percentage			Mortality (%)
			R_1	R_2	R_3	
Dimethoate 30 EC	0.06	2 ml /l	100	100	100	100.00* (90.00)^c **
Dimethoate 30 EC	0.03	1 ml /l	95	100	100	98.33 (85.68)^c
Thiamethoxam 25 WG	0.005	0.2 g/l	30	35	30	31.66 (34.21)^b
Thiamethoxam 25 WG	0.0025	0.1 g/l	20	15	25	20.00 (26.44)^b
Emamectin benzoate 5 SG	0.0011	0.22 g /l	0	5	5	3.33 (8.61)^a
Emamectin benzoate 5 SG	0.00055	0.11 g /l	0	0	5	1.66 (4.30)^a
Control	-	-	0	0	0	0.00 (0.00)
SE(m)±	1.33					
CD@5%	5.60					
CV	7.33					

*Mean of three replications, each comprising 20 adults of *C. blackburni*
** Figure in parentheses are arc sin percentage transformed values

In the results of the present study (Table 1) it was observed that thiamethoxam (0.0025%) reported 20.00, 36.66, 53.33 per cent mortality of adult *C. blackburni* followed by thiamethoxam (0.005%) showed adult mortality 31.66. 45.00 and 76.66 per cent respectively, at 12, 24 and 48 hours which indicated that it was moderately toxic to the adult of *C. blackburni*. The study was in close agreement with Preetha *et al*., (2010) [7] who revealed that thiamethoxam 25WG 25 g a.s-ha^{-1} caused 40.00 per cent and 53.33 per cent adult mortality of *C. blackburni* after 12 and 24 hours after treatments, respectively.

Plate 1: Exposure of insecticides to study the mortality of *C. blackburni*

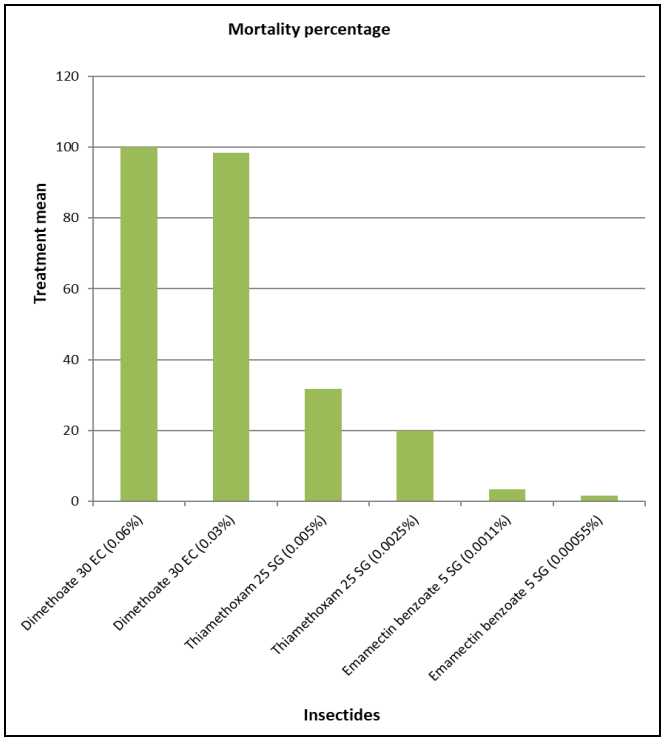

Fig 1: Influence of different insecticides at various concentrations on the mortality of adult *C. blackburni* at 12 hours after treatment

Table 2: Influence of different insecticides at various concentrations on mortality of adult *C. blackburni* at 24 hours after treatment

Treatments	Concentration (%)	Dose in Aqueous Solution	Mortality percentage			Mean
			R_1	R_2	R_3	
Dimethoate 30 EC	0.06	2 ml /l	100	100	100	100.00* (90.00)[e] **
Dimethoate 30 EC	0.03	1 ml /l	100	100	100	100.00 (90.00)[e]
Thiamethoxam 25 WG	0.005	0.2 g/l	40	50	45	45.00 (42.10)[d]
Thiamethoxam 25 WG	0.0025	0.1 g/l	40	35	35	36.66 (37.24)[c]
Emamectin Benzoate 5 SG	0.0011	0.22 g /l	15	10	10	11.66 (19.87)[b]
Emamectin benzoate 5 SG	0.00055	0.11 g /l	5	5	5	5.00 (12.91)[a]
Control	-	-	0	0	0	0.00 (0.00)
SE(m)±	1.52					
CD@5%	4.74					
CV	5.30					

*Mean of three replications, each comprising 20 adults of *C. blackburni*

** Figure in parentheses are arc sin percentage transformed values

In the results of the present study (Table 2) it was indicated that dimethoate 0.03 per cent showed 98.33, 100.00, 100.00 per cent mortality and dimethoate 0.06 per cent caused 100.00 per cent mortality in all the tested experiment at 12, 24 and 48 hours it showed more mortality because dimethoate is organophosphate group insecticide which shows fumigation effect, which indicates extremely toxic to adult *C. blackburni*. Effects were found as above by laboratory testing using limited number of test insects but there were deficit of information on this line. But some studies on other species of non-target insect found that dimethoate is extremely toxic. This is in agreement with Mani and Thontadarya (1988) reported that the dimethoate 0.06 per cent is highly toxic 100 per cent mortality to natural enemy adult of *Cryptolaemus montrouzieri*, at 24 hour after treatment.

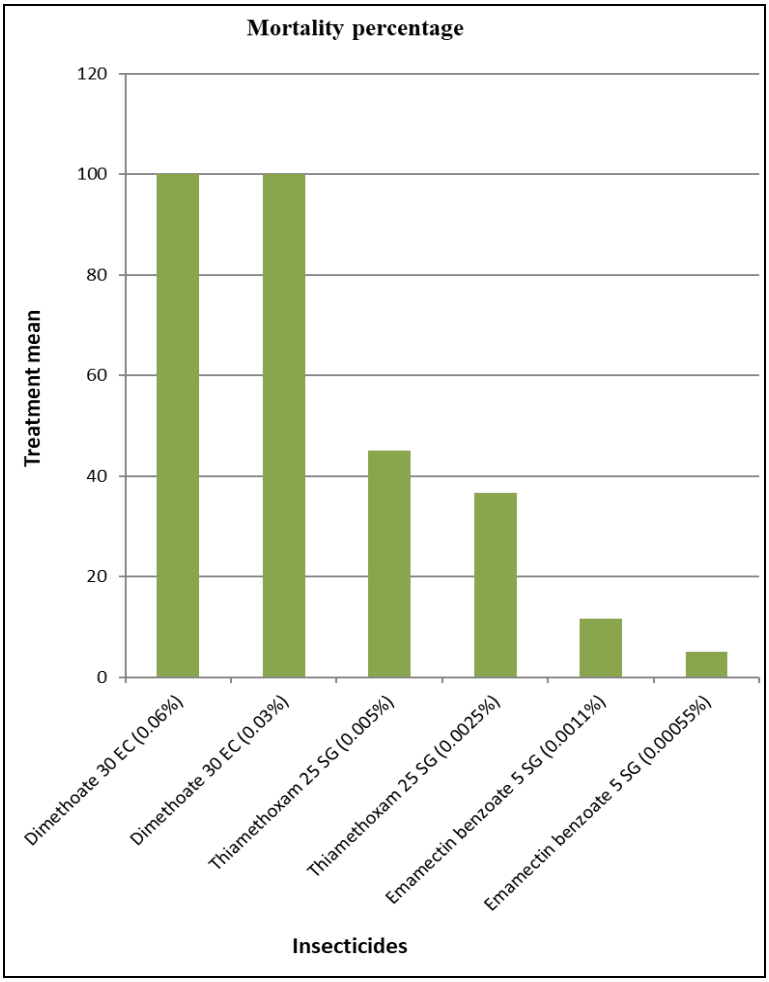

Fig 2: Influence of different tested insecticides at various concentrations on mortality of adult *C. blackburni* at 24 hours after treatment

Table 3: Influence of different tested insecticides at various concentrations on mortality of adult *C. blackburni* at 48 hours after treatment

Treatments	Concentration (%)	Dose in Aqueous Solution	Mortality percentage			Mean
			R_1	R_2	R_3	
Dimethoate 30 EC	0.06	2 ml /l	100	100	100	100.00* (90.00)^{e} **
Dimethoate 30 EC	0.03	1 ml /l	100	100	100	100.00 (90.00)^{e}
Thiamethoxam 25 WG	0.005	0.2 g/l	75	80	75	76.66 (61.12)^{d}
Thiamethoxam 25 WG	0.0025	0.1 g/l	50	55	55	53.33 (46.89)^{c}
Emamectin benzoate 5 SG	0.0011	0.22 g /l	20	15	10	15.00 (22.58)^{b}
Emamectin benzoate 5 SG	0.00055	0.11 g /l	15	10	10	11.66 (19.87)^{b}
Control	-	-	0	5	5	3.33 (8.61)^{a}
SE(m)±	1.66					
CD@5%	5.10					
CV	5.61					

*Mean of three replications, each comprising 20 adults of *C. blackburni*
** Figure in parentheses are arc sin percentage transformed values

The data on mortality of adult *C. blackbuni* after 48 hour influenced by different tested insecticides at recommended and lower concentration are reported in Table 3. It was observed from the data that different insecticides had significant influence on mortality of adult *C. blackburni*. Among different tested insecticides emamectin benzoate 0.00055 per cent recorded significantly lower mortality (11.66%) over rest of the different insecticides concentration except ememectin benzoate 0.0011 per cent, which caused 15.00 per cent mortality. Thiamethoxam 0.0025 per cent reported slightly higher mortality 53.33 per cent followed by thiamethoxam 0.005 per cent mortality, indicating moderate harmful effect. However, dimethoate 0.03 and 0.06 per cent recorded extremely higher mortality 100.00 per cent, indicating extremely toxic effect.

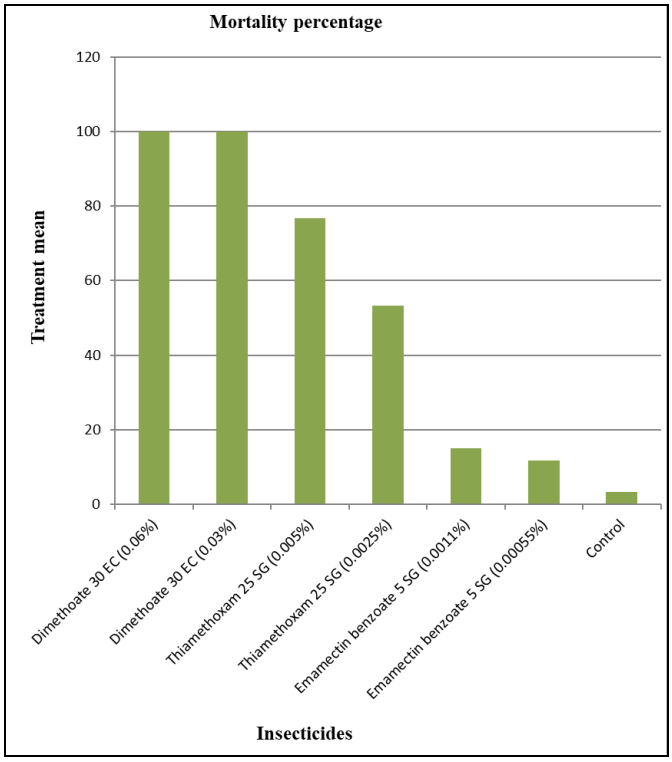

Fig 3: Influence of different tested insecticides and their concentrations on mortality of adult *C. blackburni* at 48 hours after treatment

Conclusions

The results indicated that emamectin benzoate SG @ 0.22 g and 0.11 g / l. can be used as a spray when needed in the field as it is relatively safe to the bioagent *C. blackburni* but avoid using dimethoate as it was found to be highly toxic than rest of the tested insecticides.

Acknowledgements

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