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Effect of chlorpyriphos 20 EC on Indian bees and egg parasitoid, *Trichogramma chilonis* ISHII

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Abstract
Laboratory studies were conducted to assess the safety of chlorpyriphos 20 EC on *Trichogramma chilonis* and Indian bees. Chlorpyriphos 20 EC caused mortality ranging from 68.50% to 77.00% on *Trichogramma chilonis.* Chlorpyriphos was moderately harmful to Indian bees. Maximum bee mortality was registered by chlorpyriphos 20 EC 2000 ml/ha (96.67%), 1500 ml/ha (96.67%) and 1000 ml/ha (80.00%). Dursban 20 EC 1000, chlorpyriphos 20 EC 750, Dursban 20 EC 500, chlorpyriphos 20 EC 500 and dimethoate 30 EC 333 ml/ha registered 86.67%, 76.67%, 73.33%, 70.00% and 66.67% bee mortality respectively.

Keywords: Safety**,** chlorpyriphos 20 EC, *Trichogramma chilonis,* Indian bees

Introduction
Agricultural ecosystems are replete with beneficial parasites in numbers that frequently provide partial to satisfactory pest control. Conservation of these natural enemies of crop pests involves selection of appropriate insecticides for pest management to reduce harmful effects caused by them. Insecticides are unavoidable in pest management programs especially when the pest crosses Economic Threshold Level (ETL). Nevertheless, often plant protection products kill the natural enemy population also, facilitating the pest to resurge and thus demanding more sprays. Therefore, insecticides used in IPM programs should be selective enough to spare beneficial insects. Honey bees are important pollinators. But wide spread use of broad spectrum insecticides results in declining their numbers. Results recommended that when using conventional pesticides, they must be used with appropriate formulations at right concentration, at optimum time of intervention and proper application methods to avoid natural enemies and harmful effects on pollinators.
Brunner *et al*. (2001) [3] found harmful effects of chlorpyriphos to parasitioid *Colpoclypeus florus*. Alexander *et al*. (2006) [2] registered that endosulfan and chlorpyriphos caused high adult mortality of *Trichogramma chilonis* 24, 48 and 72h after treatment. Muranjan *et al*. (2006) [10] reported that, LC_{50} values for acephate 75 SP, chlorpyriphos 20EC, triazophos 40EC, deltamethrin 2.8 EC, fenvalerate 20 EC and cypermethrin 10EC were 0.01362, 0.0009789, 0.002189, 0.0003238, 0.008443 and 0.0004493%, respectively. Acephate, chlorpyriphos and Koranda (acephate 25%+ fenvalerate 3%) were slightly toxic and Nurelle D (chlorpyriphos 50% +cypermethrin 5%) were toxic to *Apis cerana indica.* Chlorpyriphos caused 86.67% mortality (females) during 1h and it reached 100 per cent after 3h of exposure in both mealybug parasitoids*, Aenasius bambawalei* and *Aenasius advena* which was significantly higher than untreated check (Nalini and Manickavasagam, 2011) [11], whereas chlorpyriphos 20 EC (0.1%) and dichlorvos 76 EC (0.3%) showed 100% mortality at 1 hr of exposure (Sachin *et al*., 2014) [13].

Materials and Methods
Effect of chlorpyriphos 20 EC on *Trichogramma chilonis* Ishii
Corcyra eggs parasitized with *Trichogramma chilonis* were obtained from Biocontrol Laboratory, Department of Entomology, Tamil Nadu Agricultural University, and Coimbatore for conducting the following experiments. Four replications were maintained for each treatment in completely randomized design.

Treatments
The insecticides used in the present investigation and their dosages were as follows.

Table 1: Treatment details

No.	Insecticide	Dose (g.a.i./ha)	Product (ml/ha)
1	Chlorpyriphos 20 EC	100	750
2	Chlorpyriphos 20 EC	200	1000
3	Chlorpyriphos 20 EC	300	1500
4	Chlorpyriphos 20 EC	400	2000
5	Dursban 20 EC	200	1000
6	Untreated Check	-	-

Effect of chlorpyriphos 20 EC on adult emergence
The bioassay method described by Jalali and Singh (1997) [7] for *T. chilonis* was adopted with modifications. Three days old parasitized egg cards of one cm^2 was sprayed with insecticides using an atomizer at different concentrations. For untreated check, only distilled water was sprayed. The treated egg cards were shade dried for 10 minutes and then kept in a test tube of 10 x 1.5 cm size. The number of parasitoids emerged from each treatment was recorded after 48 hours of treatment and per cent emergence was worked out using the formula,

$$\text{Per cent emergence} = \frac{\text{No. of wasps emerged (eggs with emergence slit)}}{\text{Total no. of } \textit{Corcyra} \text{ eggs / cm}^2} \times 100$$

Effect of chlorpyriphos 20 EC on parasitisation
Corcyra eggs pasted on 20 x 30 cm^2 egg cards having 30 (7 x 2 cm^2) rectangles was cut into 1 cm^2 pieces, treated with insecticide solution at different concentration. The treated eggs were provided to *Trichogramma* parasitoids at 6:1 ratio and the number of parasitized eggs (egg turning black and plumpy) was recorded after 48 hours and the per cent parasitisation was worked out using the formula,

$$\text{Per cent parasitisation} = \frac{\text{No. of parasitized eggs}}{\text{Total no. of } \textit{Corcyra} \text{ eggs}} \times 100$$

The mortality data were categorized as below, (Kuttalam, 1999) [9],

Table: 2 Categorization of mortality

Mortality (%)	Category
<50	Harmless
50-80	Slightly harmful
80-99	Moderately harmful
>99	Harmful

Evaluation of toxicity of chlorpyriphos 20 EC to Indian bees, *Apis cerana indica*
Studies were conducted at the Department of Agricultural Entomology, Tamil Nadu Agricultural Entomology, Coimbatore in completely randomized design with ten treatments repeated thrice (Table 3) along with a control (water spray) during March 2014.

Table: 3 Toxicity of chlorpyriphos 20 EC to Indian bees, *Apis cerana indica*

No	Treatment	Dosage (ml. ha $^{-1}$)	After 6h*		After 12 h*		After 24 h*		Mean mortality (%)
			Mortality (%) (n = 10)	Corrected mortality (%)	Mortality (%)	Corrected mortality (%)	Mortality (%)	Corrected mortality (%)	
1	Chlorpyriphos 20 EC	250	13.33 (21.14)^{b}	13.33	36.67 (37.22)^{b}	32.14	63.33 (52.78)^{b}	60.71	37.78
2	Chlorpyriphos 20 EC	500	16.67 (23.86)^{bc}	16.67	40.00 (39.15)^{bc}	35.71	70.00 (56.79)^{bc}	67.86	42.22
3	Chlorpyriphos 20 EC	750	20.00 (26.57)^{bc}	20.00	43.33 (41.15)^{bc}	39.28	76.67 (61.22)^{bc}	75.00	46.67
4	Chlorpyriphos 20 EC	1000	23.33 (28.78)^{c}	23.33	46.67 (43.08)^{bc}	42.86	80.00 (63.93)^{bc}	78.57	50.00
5	Chlorpyriphos 20 EC	1500	23.33 (28.78)^{c}	23.33	53.33 (47.01)^{bc}	50.00	96.67 (83.86)^{d}	96.43	57.78
6	Chlorpyriphos 20 EC	2000	23.33 (28.78)^{c}	23.33	56.67 (48.85)^{c}	53.57	96.67 (83.86)^{d}	96.43	58.89
7	Dursban 20 EC (standard check)	500	16.67 (23.86)^{bc}	16.67	40.00 (39.15)^{bc}	35.71	73.33 (59.00)^{bc}	71.43	43.33
8	Dursban 20 EC (standard check)	1000	20.00 (26.57)^{bc}	20.00	50.00 (45.00)^{bc}	46.43	86.67 (68.86)^{c}	85.71	52.22
9	Dimethoate 30 EC	333	20.00 (26.57)^{bc}	20.00	36.67 (37.22)^{b}	32.14	66.67 (55.07)^{b}	64.29	41.11
10	Untreated check	-	0.00 (0.28)^{a}	-	6.67 (12.29)^{a}	-	6.67 (12.29)^{a}	-	4.44

Mean of four observations * Figures in parentheses are arcsine transformed
Means in a column with same superscripts are not significantly different by DMRT (P=0.05).

Treatments
The insecticides used in the present investigation and their dosages were as follows.

Table 4: Treatment details

No.	Insecticide	Dose (g.a.i./ha)	Product (ml./ha)
1	Chlorpyriphos 20 EC	50	250
2	Chlorpyriphos 20 EC	100	500
3	Chlorpyriphos 20 EC	150	750
4	Chlorpyriphos 20 EC	200	1000
5	Chlorpyriphos 20 EC	300	1500
6	Chlorpyriphos 20 EC	400	2000
7	Dursban 20 EC (standard check)	100	500
8	Dursban 20 EC (standard check)	200	1000
9	Dimethoate 30 EC	100	333
10	Untreated check	-	-

The relative toxicity of chlorpyriphos 20 EC on Indian bees was assessed by dry film contact toxicity method (Rajathi *et al*., 2006) [12]. Bees were collected from apiary, Tamil Nadu Agricultural University, Coimbatore. Plastic containers (10 x 8 cm) with fine perforations were used for the trial to allow adequate aeration for bees. Filter paper discs were wetted with 1 ml of different concentrations of insecticides and allowed to dry in air by hanging in a string. Shade dried filter paper was placed in the bioassay container and honey bees were released at the rate of 10 per container. Honey bees were kept in refrigerator prior to test for 4 to 6 minutes to calm them for easy transfer. After exposure for 1 hr, honey bees were transferred to a perforated polythene bag (20 X 30 cm) and cotton swabbed with 40 per cent sucrose solution tied in a twine was provided as feed for the honeybees. Mortality of bees was observed after 6, 12 and 24 hours of treatment and per cent mortality worked out using the formula,

$$\text{Per cent mortality of bees} = \frac{\text{No. of bees dead}}{\text{Total number of bees treated}} \times 100$$

Results and Discussion

Effect of chlorpyriphos 20 EC on *Trichogramma chilonis* Ishii

The results showed that chlorpyriphos had significant impact on adult emergence and parasitization efficiency (Table 5). The untreated check recorded maximum per cent adult emergence of 96.00 and maximum per cent parasitization of 93.67. Chlorpyriphos 20 EC 750 ml/ha recorded 31.50 per cent adult emergence and 19.17 per cent parasitization followed by chlorpyriphos 20 EC 1000 ml/ha (29.67% and 18.17%), Dursban 20 EC 1000 ml/ha (29.33% and 17.50%), chlorpyriphos 20 EC at 1500 ml/ha (23.83% and 14.33%), chlorpyriphos 20 EC 2000 ml/ha (23.00% and 14.00%). Chlorpyriphos 20 EC doses were harmful and mortality ranged from 68.50% to 77.00% (Table 5). Sithanantham and Navarajan Paul (1980) [15] also observed that chlorpyriphos was the most toxic to adults of *Trichogramma australicum* causing more than 50 per cent mortality upto 9 days after spray and phosalone, chlorpyriphos recorded an average survival of 1.0 and 4.2 per cent respectively. Dhawan (2000) [6] reported that abamectin and spinosad (Avermectins) were safer compared to chlorpyriphos, methyl demeton and quinalphos. Bull and Coleman (1985) [4] reported that *T. chilonis* was the least tolerant to methyl parathion and most tolerant to permethrin. Chlorpyriphos was highly toxic to *Trichogramma australicum* (Sithanantham and Navarajan Paul, 1980) [15].

Siddharth Tiwari and Khan (2002) [14] observed the lowest (44.0%) parasitization of *Trichogramma chilonis* with chlorpyriphos methyl at 0.30% and high parasitization of 51.33 per cent was recorded with chlorpyriphos methyl at 0.05%.

Table 5: Effect of chlorpyriphos 20 EC on *Trichogramma chilonis* Ishii

Treatment	Dosage (ml.ha $^{-1}$)	Adult emergence* (%)	Adult mortality (%)	Parasitization * (%)
Chlorpyriphos 20 EC	750	31.50 (34.14)^{b}	68.50	19.17 (25.96)^{b}
Chlorpyriphos 20 EC	1000	29.67 (33.00)^{c}	70.33	18.17 (25.23)^{c}
Chlorpyriphos 20 EC	1500	23.83 (29.22)^{d}	76.17	14.33 (22.24)^{d}
Chlorpyriphos 20 EC	2000	23.00 (28.66)^{d}	77.00	14.00 (21.97)^{d}
Dursban 20 EC (standard check)	1000	29.33 (32.79)^{bc}	70.67	17.50 (24.72)^{c}
Untreated check	-	96.00 (78.71)^{a}	4.00	93.67 (75.43)^{a}

Mean of four observations * Figures in parentheses are arcsine transformed

Means in a column with same superscripts are not significantly different by DMRT (P=0.05).

Evaluation of toxicity of chlorpyriphos 20 EC to Indian bees, *Apis cerana indica*

Mortality of bees was observed at 6, 12 and 24 hours after treatment (Table 3). The untreated check recorded minimum mortality (6.67 per cent) at 24 hours after treatment followed by chlorpyriphos 20 EC 250 ml/ha (63.33%) and dimethoate 500 ml/ha (66.67) (Table 3) whereas, chlorpyriphos 20 EC 2000 ml/ha 96.67%) chlorpyriphos 20 EC 1500ml/ha (96.67%), chlorpyriphos 20 EC 1000 ml/ha (80.00%) caused the maximum mortality. Dursban 20 EC 1000, Chlorpyriphos 20 EC 750, Dursban 20 EC 500, Chlorpyriphos 20 EC 500 and Dimethoate 30 EC 333 ml/ha registered 86.67%, 76.67%, 73.33%, 70.00% and 66.67% mortality respectively. Higher doses of chlorpyriphos 20EC were moderately harmful to the bees, the per cent mortality ranging from 80.00 to 96.67 (Table 3).

These results are in line with Kalita and Rahman (1994) [8] who reported that chlorpyriphos 20 EC at 0.01, 0.02 and 0.03% recorded 100 per cent mortality of bees after 24 hours of treatment. Venkata Reddy and Chandrashekhara (2006) [16] reported that dimethoate was more toxic to honey bees. Chlorpyriphos was most toxic, whereas deltamethrin and neem oil showed least toxicity to *Apis cerana indica* F. Ahmed and Rahman (1994) [1] reported that fluvalinate and endosulfan were less toxic to Indian bees compared to malathion, phosphamidon and dimethoate. Chandramani *et al*. (2008) [5] observed the descending order of oral toxicity of 10 test insecticides as; cypermethrin >monocrotophos > endosulfan > dimethoate > thiomethoxam > imidacloprid > spinosad >pungam oil > neem oil > NSKE.

References

1. Ahmed SSG, Rahman A. Efficacy of certain insecticides against mustard aphid, *Lipaphis erysimi* Kalt. and their toxicity to honey bee, *Apis cerana indica* F. Pestology. 1994; 18(3):25-28.
2. Alexander B, Rajavel DS, Suresh K. Effect of new insect growth Regulators (IGRS) on *Trichogramma chilonis* Ishii. Hexapoda. 2006**;** 13:66-69.
3. Brunner JF, Dunley JE, Doerr MD, Beers EH. Effect of pesticides on *Colpoclypeus florus* (Hymenoptera: Eulophidae) and *Trichogramma platner* (Hymenoptera: Trichogrammatidae) parasitoids of leaf rollers in Washington. Journal of Economic Entomology. 2001; 94(5):1075-1084.
4. Bull DL, Coleman RJ. Effect on pesticides on *Trichogramma* spp. Southwest. Entomology. 1985; 8:46-53.
5. Chandramani P, Usha Rani B, Muthiah C, Kumar S. Evaluation of toxicity of certain insecticides to Indian honeybee *Apis cerana indica* F. Pestology. 2008; 35(8):42-43.
6. Dhawan AK. Impact of some new insecticides on natural enemy complex of cotton ecosystem. Pestology. 2000; 24(5):8-14.
7. Jalali SK, Singh SP. Susceptibility of various stages of *Trichogramma toidea armigera* to some pesticides and effect of residues on survival and parasitizing ability. Biocontrol Science Technology. 1997*;* 3:21-27.
8. Kalita H, Rahman A. Bioefficacy of certain insecticides against mustard aphid *Lipaphis erysimi* Kalt. and their toxicity to honey bee, *Apis cerana indica* F. Pestology. 1994; 18(1):21-26.
9. Kuttalam S. Safety of insecticides to entomophages. In: Emerging Trends in Biological Control, (Eds.) K.A. Ali, R.J. Rabindra, P. Karuppuchamy, B. Rajasekaran and J.S. Kennedy. Tamil Nadu Agricultural University, Coimbatore, India, 1999, 213-218.
10. Muranjan PN, Gandhale DN, Chaudhari CS, Patil BD, Pokharkar DS, Naik RL. Toxicity of ready-mix formulations of pyrethroids and ad-mixed insecticides on forager honey bee, *Apis cerana indica* Fabricius. Annals of Plant. Protection. Sciences. 2006; 14(1):90-93.
11. Nalini T, Manickavasagam S. Toxicity of selected insecticides to mealybug parasitoids, *Aenasius bambawalei* Hayat and *Aenasius advena* Compere (Hymenoptera: Encyrtidae). Journal of Biological Control. 2011; 25(1):14-17.
12. Rajathi DS, Krishnamoorthy SV, Regupathy A. Selective toxicity and discriminating dose of lambda cyhalothrin 5 CS against *Earias vittella* Fab. Resistant Pest Management. Newsletter. 2006; 15(2):35-38.
13. Sachin SS, Gautam RD, Babasaheb B. Fand. Safety of insecticides against *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae). Indian Journal of Entomology. 2014; 76(3):224-228.
14. Siddharth Tiwari, Khan MA. Effect of fenobucarb and chlorpyrifos–methyl on the parasitization by *Trichogramma chilonis* Ishii. Pestology. 2002*;* 26(3):40-43.
15. Sithanantham S, Navarajan Paul AV. Toxicity of some insecticidal sprays to the parasitoid, *Trichogramma australicum*. Pestology. 1980*;* 4(3):21-24.
16. Venkata Reddy E, Chandrashekhara Reddy C. Oral and dermal toxicity of some insecticides to Indian honey bee, *Apis cerana* F. Journal of Entomological Research. 2006; 30(1):47-49.