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Evaluation of Carbosulfan 25 EC on the egg parasitoid, *Trichogramma chilonis* Ishii (Hymenoptera, Trichogrammatidae)

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ABSTRACT: Experiments to ensure the safety of carbosulfan, to *Trichogramma chilonis* Ishii in terms of adult emergence and parasitization by direct spraying on egg card technique, revealed significant adverse effect on adult emergence and parasitization. The number of adult emergence ranged from 41.96 to 58.0 and, parasitization 12.62 to 32.6 per cent at 24 HAT; while it was 44.03 to 64.63 and 18.95 to 38.8 per cent respectively at 48 HAT for all the tested three doses of carbosulfan 25 EC @ 250, 500 and 1000 g a.i ha^{-1}. Carbosulfan 25 EC @ 250g a.i ha^{-1}, recorded maximum adult emergence (58.00 at 24 HAT and 64.63 at 48 HAT) and maximum per cent parasitization (32.60 at 24 HAT and 38.80 at 48 HAT). Hence usage of carbosulfan 250 EC is recommended only at the low dose of 250g a.i. ha^{-1}.

KEY WORDS: Parasitisation, parasitoid emergence, *Corcyra* eggs, dose

Trichogramma species has achieved appreciable pest control success in several crop ecosystems and its role in the biological control programs is well understood (Smith, 1996; Hussain *et al.,* 2010; Pawar *et al*., 2023). *Trichogramma* can survive in a wide range of temperature and provide successful management of lepidopteran pests in quite a lot of crops (Nadeem and Hamed, 2008, 2011; Nadeem *et al.,* 2009, 2010). Several studies have revealed the susceptibility of *Trichogramma* wasps to most insecticides. Rajendran and Gopalan (1996), Sarkar *et al*. (1998), Charles *et al.* (2000), Williams and Price (2004), Preetha *et al.* (2009, 2010), Sattar *et al.* (2011) and Wang *et al.* (2014) indicated toxic effects of different insecticides on *Trichogramma* spp. *Trichogramma chilonis* Ishii (Hymenoptera, Trichogrammatidae) is an effective biocontrol agent in integrated pest management (Pawar *et al.,* 2023). A study was undertaken to study the safety of carbosulfan against *T. chilonis* under laboratory conditions at different doses with an objective to search for comparatively apt dose, to be incorporated in the IPM program.

Mass culture of *T. chilonis* wasps were maintained in the Biocontrol Laboratory, TNAU, Coimbatore, on the eggs of *Corcyra cephalonica* (Stainton) as per the method described by Prabhu (1991). Fresh *C. cephalonica* eggs were collected and sterilized under UV radiation of 15W capacity for 20 minutes duration at a distance of 20cm to avoid the emergence of *Corcyra* larvae. Then these eggs

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were pasted on paper cards of 21 x 30cm size having thirty 7 x 2 rectangles. These egg cards were placed in plastic bags along with the nucleus card at 6:1 ratio for parasitization. The parasitized egg cards were cut into one cm^2 bits and three days old hundred percent parasitized eggs (eggs appearing black and plumpy) were sprayed with insecticides at different concentrations mentioned using an atomizer. Distilled water was sprayed for untreated check. The treated egg cards were shade dried for 10 minutes and then kept in a test tube of 10 x 0.5cm size. The number of parasitoids emerged from each treatment was recorded after 24 and 48 hours of treatment and per cent emergence was worked out using the formula,

$$\text{Emergence (\%)} = \frac{\text{No. of wasps emerged}}{\text{Total no. of eggs in 1 cm}^2} \times 100$$

Fresh eggs were provided to these parasitoids at 6:1ratio and the number of parasitized eggs (eggs appearing black and plumpy) were recorded after 24 and 48 hours of treatment and percent parasitization was worked out using the formula,

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

The data were transformed to and analysed by completely randomized design. The treatment mean values of the experiment were compared using Duncan's Multiple Range Test (Gomez and Gomez, 1984). The corrected per cent mortality for lab studies was worked out (Abbott, 1925).

$$\text{Corrected percent mortality} = \frac{P_o - P_c \times 100}{(100 - P_c)}$$

Where, Po - Observed mortality in treatment; Pc - Observed mortality in untreated check

Corrected per cent mortality were transformed using arc sine transformation for normalization of data (Snedecor and Cochran,1967; Steel *et al.,* 1997).

Evaluation revealed that carbosulfan @ 250, 500 and 1000g a.i. ha^{-1} had significant adverse effect on adult emergence after 24 HAT (41.96-58.0%) and 48 HAT (44.03-64.63%). The normal dose of carbosulfan 25 EC @ 250g a.i. ha^{-1} recorded a safe rate of adult emergence (58.00 and 64.63% at 24 and 48 HAT respectively). But the higher doses, @ 500 and 1000g a.i. ha^{-1} the adult emergence was rather low (46.47 and 51.42 at 24 HAT and 41.96 and 44.03% at 48 HAT), exposing it is more toxic nature. In untreated check, adult emergence was 85.55 and 82.60 per cent after 24 and 48 hours of treatment respectively (Table 1). The results on parasitization also revealed that carbosulfan at all the doses tested affected parasitization significantly. The untreated check recorded maximum parasitization (80.66 and 83.56% at 24 and 48 HAT respectively). Of the three doses of carbosulfan tested, the recommended dose, 250g a.i. ha^{-1} recorded better parasitization (32.6 and 38.8% at 24 and 48 HAT respectively) and was on par with the standard check, dimethoate @300g a.i. ha^{-1}

Table 1. Effect of carbosulfan 25 EC on the parasitoid, *Trichogramma chilonis* (Mean of five observations)

No.	Treatments	Adult emergence (%)		Parasitization (%)	
		24 HAT	48 HAT	24 HAT	48 HAT
T_1	Carbosulfan 25 EC @ 250 g a.i. ha^{-1}	58.00(42.60)^c	64.63(53.51)^c	32.60(34.82)^c	38.80(38.53)^c
T_2	Carbosulfan 25 EC @ 500 g a.i. ha^{-1}	46.47(42.96)^d	51.42(45.81)^d	18.45(25.44)^d	22.46(28.29)^d
T_3	Carbosulfan 25 EC @ 1000 g a.i. ha^{-1}	41.96(40.37)^e	44.03(41.57)^e	12.62(20.81)^e	18.95(25.80)^e
T_4	Dimethoate 30 EC @ 300 g a.i. ha^{-1}	62.02(51.95)^b	65.61(54.09)^b	36.98(37.45)^b	40.66(39.61)^b
T_5	Untreated control	85.55(67.66)^a	82.60(65.35)^a	80.66(63.91)^a	83.56(66.08)^a

HAT - Hours after treatment; In a column means followed by a common letter are not significantly different by DMRT (p=0.05) ; Values in parentheses are arc sine transformed values

(36.98 and 40.66% at 24 and 48 HAT respectively). Higher dose of carbosulfan@ 500 and 1000g a.i. ha^{-1} showed lower adult emergence (18.45% at 24 HAT and 22.46% at 48 HAT) and parasitization (12.62 and 18.95% respectively after 24 and 48 HAT).

The present findings corroborated the earlier reports with different insecticides against *T. chilonis*. Carbaryl (0.15%) and triazophos (0.15%) were more toxic to *T. chilonis* (Gangathara *et al.,* 1990). Madhu *et al.* (2014) found toxicity of flubendiamide 20 WG against the egg parasitoid. Studies revealed that the carbamate insecticides adversely affected parasitzation of *T. chilonis* (Tiwari and Khan, 2002). Preetha *et al*. (2009) reported toxicity of imidacloprid to *T. chilonis*. The studies on the safety of carbosulfan on the parasitoid *T. chilonis* revealed substantial adverse effect on the adult emergence and parasitization, which ranged from 41.96 to 58.0 and 12.62 to 32.6 per cent at 24 HAT, but slowly rebounded to 44.03 to 64.63 and 18.95 to 38.8 per cent at 48 HAT. Therefore, the chemical is considered to have toxic effect immediately after application, but the toxicity gets reduced in time. Carbosulfan systemic insecticide, was found to be toxic to the egg parasitoid, *T. chilonis*, based on adult emergence and per cent parasitization. However, the recommended dose of carbosulfan 250g a.i. ha^{-1} is found to be less toxic to the egg parasitoids and is recommended for usage in any crop, if there is a severe pest outbreak.

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