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Effect of common insecticides on emergence and parasitism of *Trichogramma chilonis* Ishii (Hymenoptera: Trichogrammatidae)

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ABSTRACT: **Four insecticides commonly used in the management of cotton pests were field tested for their deleterious effects on an effective egg-parasitoid, *Trichogramma chilonis* Ishii. Endosulfan (0.05%) proved to be safer than quinalphos (0.05%), monocrotophos (0.04%) and fenvalerate (0.04%). Both, the emergence and parasitism of *T. chilonis* decreased gradually as the time increased from 12 to 72h in all treatments including control.**

KEY WORDS: Cotton, *Corcyra cephalonica*, *Helicoverpa armigera*, insecticides, *Trichogramma chilonis*

In India, the major hurdle in cotton production is the cost of insecticides, which are used indiscriminately resulting in pest resistance to the commonly used molecules, toxicity to beneficial organisms, toxic residues in cotton lint and resurgence of certain pests. Therefore, need of integrated pest management has been emphasised (Sundaramurthy and Gahukar, 1998). The suppression of pest population has been successfully achieved by using effective parasitoids in India and elsewhere. The egg parasitoid, *Trichogramma chilonis* Ishii is efficient under natural conditions and also when field releases are made in large areas. It can easily be reared in the laboratory and used for both inoculative and inundative releases (Gahukar, 1997a). Progressive farmers in Maharashtra use *T. chilonis* in cotton against lepidopteran pests, and particularly *Helicoverpa armigera* (Hübner) along with pesticides. The present study was undertaken to know the effect of four commonly used insecticides at recommended doses on the emergence and parasitism of *T. chilonis* so that the safer ones can be advocated for their integration while formulating economical, effective and eco-friendly pest management in cotton.

MATERIALS AND METHODS

The cotton hybrid NHH-44 was sown in June and the plot size was 125m^2 with 90x60cm planting spacing. The field trials were conducted during two consecutive cropping seasons, namely, 1995 and 1996, in a randomised block design having five treatments, replicated four times. The treatments, *viz.*, endosulfan (0.05%), quinalphos (0.05%) monocrotophos (0.04%) and fenvalerate (0.04%) were given using knapsack sprayer @ 500 litres of spray fluid/ha, whereas, only water was sprayed in control plots. The insecticides were sprayed, when the plants were 70 days old and the eggs of *Earias vittella* (Fabricius), and *H. armigera* were noticed on them. The cultures of *T. chilonis*, *Corcyra cephalonica* (Stainton) and

H. armigera were maintained in the laboratory at 27 ±1°C and 60±5 per cent relative humidity.

Two sets of experiments were laid out. In each set, 100 eggs of *C. cephalonica* and *H. armigera* were pasted on cheesecloth cards of 5x5cm. Exposing them to ultra-violet rays inactivated these eggs. The cards were transferred into suitable containers for transportation to the field and were hung on branches in the middle of crop canopy on plants selected at random.

In the first experiment, spraying was done immediately after placing the cards and eggs were allowed to be parasitised naturally. The cards were collected and brought to the laboratory at 24, 48 and 72h after spraying and were placed separately into plastic jars of which bottom was covered with black paper and the top with a glass plate. Observations were recorded on rate of parasitism by *T. chilonis* based on percentage of eggs of host insects turning black due to pupation of the parasitoid inside, and the rate of emergence based on number of adult parasitoids emerging from the parasitised eggs.

In the second experiment, inactivated eggs were placed in glass jars @ one card/jar and 10 pairs of *T. chilonis* adults were released in each jar for parasitisation of eggs of host insects. A streak of honey on the inner walls of jar served as diet for adults. After 24 h, egg-cards were taken out and placed in the field. Spraying of insecticides was done at recommended doses and cards were removed and brought to the laboratory after 12, 24 and 48 h in 1996 and 12, 24, 36 and 48h in 1997. The cards were kept in jars and the emergence and parasitism was noted as mentioned above.

The data were transformed to arcsine values for the percentage of emergence and percentage parasitisation and were statistically analysed ($P<0.05$).

RESULTS AND DISCUSSION

It is evident from the results (Table 1) that highest (mean) emergence of *T. chilonis* on the eggs of *C. cephalonica* in both the years was observed in endosulfan-treated plots (33.3 and

Table 1. Mean per cent emergence of *T. chilonis* from insecticide exposed *C. cephalonica* eggs

Treatment	1996			1997			
	Hours after spraying						
	12	24	48	12	24	36	48
Endosulfan (0.05%)	33.25 (35.19)	41.00 (46.72)	15.50 (23.13)	27.00 (31.31)	47.00 (43.28)	39.00 (38.64)	21.25 (27.27)
Quinalphos (0.05%)	21.00 (27.24)	31.75 (34.28)	9.75 (18.16)	16.50 (23.91)	29.50 (32.89)	18.00 (24.91)	7.50 (5.61)
Monocrotophos (0.04%)	15.25 (22.93)	12.75 (20.84)	6.25 (14.24)	14.50 (22.31)	10.75 (18.94)	7.00 (15.19)	4.75 (12.18)
Fenvalerate (0.04%)	25.00 (29.90)	33.75 (35.45)	6.00 (13.93)	23.75 (29.14)	24.75 (29.81)	18.25 (25.26)	4.25 (11.18)
Control (water spray)	66.27	65.91	40.37	66.54	65.59	50.51	14.25
CD (P=0.05)	2.82	2.53	4.50	3.58	4.21	5.18	5.23
SD ±	1.29	1.16	2.07	1.65	1.93	2.38	2.39
CV (%)	5.04	4.04	13.30	6.72	7.17	10.88	19.20

Table 2. Mean per cent emergence of *T. chilonis* from insecticide exposed *H. armigera* eggs

Treatment	1996			1997			
	Hours after spraying						
	12	24	48	12	24	36	48
Endosulfan (0.05%)	43.00 (40.98)	29.50 (32.88)	8.50 (16.86)	43.60 (41.26)	25.00 (29.76)	19.25 (29.94)	15.75 (23.19
Quinalphos (0.05%)	32.25 (34.59)	17.25 (24.53)	5.25 (12.83)	30.50 (33.47)	15.25 (16.61)	9.00 (22.88)	4.75 (12.45)
Monocrotophos (0.04%)	15.00 (22.75)	2.25 (8.59)	1.25 (6.34)	13.00 (21.10)	2.00 (9.80)	2.25 (7.90)	10.75 (19.11)
Fenvalerate (0.04%)	23.00 (28.65)	10.25 (18.49)	2.50 (8.85)	21.75 (27.70)	5.00 (34.12)	5.25 (12.64)	3.00 (9.58)
Control (water spray)	92.00 (73.59)	68.00 (54.56	29.00 (32.57)	89.75 (71.50)	65.25 (56.58)	43.75 (53.92)	43.75 (53.92)
CD (P=0.05)	1.41	3.00	2.49	3.58	3.55	4.47	3.03
SD ±	0.65	1.38	1.14	1.64	1.40	2.05	1.39
CV (%)	2.29	6.96	10.44	5.96	8.91	11.38	11.20

33.5%) followed by fenvalerate and quinalphos (7.7-21.5%), the least being in the plots treated with monocrotophos.

The emergence was 60-70 per cent in unsprayed plots. As the eggs were left in the field after spraying for a long time, there was a gradual decrease in emergence of the parasitoid. In case of *H. armigera* eggs, similar trend was observed for the insecticides tested, namely, endosulfan (26-27%), fenvalerate (19-21%), quinalphos (15-18%) and monocrotophos (6-7%) compared to control plots (63%) (Table 2).

The parasitism levels of *C. cephalonica* eggs were the highest in control plots (>56%) followed by endosulfan (20-21%), fenvalerate (13-16%), quinalphos (1-14%) and monocrotophos (4-5%)(Table 3). The per cent parasitisation of *H. armigera* was in the order of 55-56, 19-20, 13-14, 7-8 and 4 in control, endosulfan, fenvalerate and monocrotophos, respectively (Table 4). It is certain that the time lapsed after spraying was an important factor as evidenced from the emergence and parasitism. Thus the cocoons of *T. chilonis* were less affected after 24-36h.

Considering the emergence percentage of adult parasitoids and level of parasitism of both host insects, significant differences for parasitism level were observed in monocrotophos being the most toxic amongst the tested insecticides on *T. chilonis*. The spraying with endosulfan proved to be safer than all other insecticides tested at recommended doses. Generally, synthetic insecticides are detrimental to egg-parasitoids than plant products and biopesticides (Jhansi Lakshmi *et al.*, 1997; Fan, 1998). Varma *et al.* (1998) tested 15 insecticides on *Trichogramma achaeae* Nagaraja and Nagarkatti and found fenvalerate (0.016%) less toxic than other synthetic insecticides. In the present study, even at higher dose (0.04%), it was comparatively safer. It is also possible to follow skip-row coverage instead of

Table 3. Mean per cent parasitism of *T. chilonis* from insecticide exposed *C. cephalonica* eggs

Treatment	1996			1997		
	Hours after release of *T. chilonis*					
	24	48	72	24	48	72
Endosulfan (0.05%)	37.75 (37.89)	14.75 (22.56)	6.50 (14.51)	43.50 (41.25)	14.75 (22.49)	4.00 (11.15)
Quinalphos (0.05%)	21.25 (27.41)	10.75 (19.05)	2.00 (7.99)	27.00 (31.07)	10.75 (19.12)	5.00 (12.44)
Monocrotophos (0.04%)	9.25 (17.58)	2.00 (7.99)	2.50 (8.98)	10.50 (16.91)	2.75 (14.45)	4.50 (11.91)
Fenvalerate (0.04%)	20.75 (6.99)	14.75 (22.54)	5.00 (12.56)	25.00 (29.96)	17.00 (24.33)	7.50 (15.54)
Control (water spray)	82.00 (65.05)	62.25 (52.11)	23.75 (29.13)	84.50 (66.96)	65.25 (53.91)	22.00 (27.86)
CD (P=0.05)	3.95	2.79	2.50	5.09	7.19	4.76
SD ±	1.81	1.28	1.15	2.34	3.30	2.18
CV (%)	7.33	7.29	11.10	8.88	17.38	19.55

Table 4. Per cent parasitism of *T. chilonis* from insecticide exposed *H. armigera* eggs

Treatment	1996			1997		
	Hours after release of *T. chilonis*					
	24	48	72	24	48	72
Endosulfan (0.05%)	35.50 (36.53)	16.75 (24.14)	6.00 (13.88)	34.50 (41.25)	17.00 (22.49)	8.50 (16.38)
Quinalphos (0.05%)	15.75 (23.31)	4.50 (12.16)	2.75 (9.19)	13.25 (31.07)	7.25 (19.12)	2.75 (9.05)
Monocrotophos (0.04%)	9.00 (17.33)	2.00 (7.79)	2.75 (9.43)	14.00 (16.92)	1.75 (14.45)	2.00 (7.99)
Fenvalerate (0.04%)	25.75 (30.39)	14.25 (22.11)	1.50 (6.94)	25.75 (29.96)	14.25 (24.33)	2.00 (7.79)
Control (water spray)	92.50 (74.15)	52.50 (46.44)	19.00 (25.79)	90.25 (66.96)	56.00 (53.91)	21.50 (27.59)
CD(P=0.05) 4.28	3.38	3.59	5.09	7.19	3.55	
SD ±	1.97	1.55	1.65	2.34	3.30	1.63
CV (%)	7.65	9.74	17.87	8.88	17.38	16.76

blanket spray (Surulivelu and Kumaraswami, 1989) since it helps the parasitoid to survive and multiply in refugia and unsprayed areas, and its population is better conserved in any ecosystem (Gahukar, 1997b).

Two years' data indicated that parasitism of *T. chilonis* is certainly affected when eggs are exposed to these insecticides. Endosulfan has least influence on the eggs of host insects at 24h after spraying. But similar trend was not noticed in other time intervals. There was a decline in the rate of emergence as the eggs aged in the field in the presence of insecticidal residues. The cocoons of *T. chilonis* were least affected at 24 and 36h exposure of eggs of both host insects. These findings suggest that there was waning effect of endosulfan beyond 24h compared to monocrotophos (24-36h exposure), which is extensively used insecticide on cotton.

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