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Studies on the Comparative Efficacy of *Trichogramma chilonis* Ishii (Hymenoptera:Trichogrammatidae), Insecticides and Integration of *Trichogramma* with Insecticides for the Suppression of Cotton Bollworms

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ABSTRACT

The comparative efficacy of *Trichogramma chilonis* Ishii (8 releases @ 1,50,000 parasitized eggs/ha), *T. chilonis* 8 releases +5 insecticidal sprays (3 of oxydemeton methyl 0.075 % and one each of cypermethrin 0.016 % and carbaryl 0.4%) and insecticide treatments having seven sprays (3 of oxydemeton methyl, 2 of cypermethrin and one each of carbaryl and fenitrothion 0.34%) against cotton bollworms was studied. The number of bolls per plant in *T. chilonis*, *T. chilonis* +insecticides and insecticide treatments was 38.8, 46.3 and 47.2 respectively and they were significantly higher than in control (19.4). The damage to loculi was significantly higher in control (47.5 per cent) while in *T. chilonis*, *T.chilonis* + insecticide and insecticide treatments it was 30.2%, 13.1% and 10.1% respectively and the latter two treatments were on par with each other. The highest yield was obtained with insecticide treatment (19.7 Q/ha) followed by *T. chilonis* + insecticide treatment (18.6 Q/ha) and *T. chilonis* treatment (12.1 Q/ha). The yield in control was 8.6 Q/ha.

KEY WORDS: Cotton bollworms, *Trichogramma chilonis*, insecticides, integrated control

The cotton bollworms, *Pectinophora gossypiella* (Saunders), *Earias vittella* (Fabricius), *Earias insulana* (Boisduval) and *Helicoverpa armigera* (Hubner) are serious insect pests of cotton in the Punjab. Seven to nine sprays of insecticides are recommended to control the cotton pest complex (Anonymous, 1990). Sole reliance on chemical control during the last 2 decades has increased the cost of cultivation and created problems like pest resurgence, secondary pest outbreaks, pollution and toxicity to non-target species (Bindra and Varma, 1976). The indiscriminate use of insecticides in cotton growing belts of the state have eliminated egg parasitoids up to 90 per cent and larval parasitoids upto 40-50 per cent while there was negligible effect on the pupal parasitoids (Varma, 1989). The inundative releases of egg parasitoids (*Trichogramma* spp.) proved effective for the control of cotton bollworms (Awate *et al.*, 1977; Varma and Maninder, 1983; Varma, 1989) but were not as effective as chemical control because of damage by sucking pests which remained unchecked in biocontrol treatments (Varma and Gill, 1990; Brar *et al.*, 1991). The present studies were therefore, undertaken to explore the possibility of integration of egg parasitoids with chemical control.

MATERIALS AND METHODS

The studies on comparative efficacy of *T.chilonis*, insecticides and *T. chilonis*, + insecticides against *P.gossypiella*, *E.insulana*, *E. vittella* and *H.armigera* were carried out at Regional Research Station, Punjab Agricultural University, Bathinda during 1991. Four

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isolated fields of cotton variety LH-1134 each measuring 0.2 ha and sown on 13 June, 1991 were selected for parasitoid treatment, insecticide treatment, insecticides integrated with parasitoid treatment and control.

Eight releases of *T.chilonis* at the rate of 1,50,000 parasitized eggs/ha were made on 31 July, 13 and 21 August, 8, 19 and 30 September, 10 and 22 October in both *T. chilonis* and *T. chilonis* +insecticides treatments. The releases were made at 10-12 days interval and one release was missed during August due to bad weather. The cards bearing eggs of *Corcyra cephalonica* (Stainton) were stapled on the lower suface of the leaves. In *T. chilonis* + insecticides treatment, five rounds of sprays were combined with 8 releases of egg parasitoids based on the preliminary experiments (Anonymous, 1991). The parasitoids were released 3-5 days after spraying. The insecticides used in this treatment consisted of three sprays of oxydemeton methyl 0.075% (Metasystox 25 EC) on 3, 13 and 27 September and one each of cypermethrin 0.016% (Cymbush 25 EC) on 14 September and carbaryl 0.4% (Sevin 50 WP) on 5 October. These five rounds of insecticides were sprayed 13, 5, 6, 7 and 6 days after the release of parasitoids respectively.

In insecticide treatment, 7 applications were made, i.e. 3 of oxydemeton methyl 0.075% on 3, 13 and 27 September, 2 of cypermethrin 0.016% on 16 August and 14 September and one each of fenitrothion 0.34% (Folithion 50 EC) on 5 September and carbaryl 0.4% on 5 October. The insecticides were sprayed with the help of motorized knapsack sprayer using 37 litres of water for each treatment. The sprays of oxydemeton methyl were made to check sucking pests while rest of the insecticides were used against the bollworms.

The incidence of cotton bollworms in green bolls was recorded from 3 plants from July to October at fortnightly intervals. There were four replications and the data were analysed by using complete Block Design as suggested by Gomez and Gomez (1984). The damage by cotton bollworms in shed material was recorded from five quadrats of 1 m^2 at fortnightly intervals from July-October and data were analysed by Complete Block Design.

The data on number of bolls per plant were recorded on 11th November, 1991 from 10 plants under each treatment and this was repeated 5 times. The damage in loculi and open bolls was recorded from these bolls after plucking and data were analysed by Randomized Block Design. The yield was also recorded. The recovery test was carried out by exposing 6 h - old eggs of *E. vittella* in all the treatments during September and October. During each round of recovery tests, 5 cards bearing 100 eggs of the host were exposed for 24 h in the field on 9th day after the parasitoid releases. After 24 h, they were brought to the laboratory and examined individually for emergence of parasitoids.

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that the mean damage by *P. gossypiella* and *Earias* sp. in green bolls was significantly higher in control (11.5 per cent) than in the other treatments. There was no significant difference in damage in *T. chilonis* + insecticides and insecticide treatment showing 5.9 and 4.3 per cent attack respectively. The former was also on par with *T. chilonis* treatment (8.3 per cent damage) which, in turn, was on par with control. The damage by cotton bollworms in the green bolls was observed from the second fortnight of August. There was a significant increase in damage during the second fortnight of September and subsequently there was no significant increase.

The data presented in Table 2 revealed that damage in shed buds was significantly higher in control (27.3 per cent) than in insecticide (16.3 per cent) and *T. chilonis* + insecticide (16.8 per cent) treatments. The *T.*

Table 1. Incidence of cotton bollworms in green bolls in different treatments

Month	Fortnight	Green bolls attacked (%)				
		T. chilonis	*T. chilonis* + 5 insecticide sprays	Insecticide (7 sprays)	Control	Mean
August 1991	II	1.9 (4.5)	1.3 (3.6)	1.9 (4.5)	11.8 (19.1)	4.2 (7.9)
September	I	10.2 (17.0)	6.7 (14.4)	1.7 (4.1)	1.3 (3.7)	4.8 (9.8)
	II	8.4 (20.3)	10.5 (20.8)	12.7 (22.2)	18.3 (28.0)	12.5 (22.8)
October	I	20.0 (30.1)	11.4 (21.2)	6.5 (16.4)	24.2 (32.7)	15.7 (25.1)
	II	17.0 (26.8)	11.1 (21.4)	7.6 (17.8)	21.4 (30.5)	14.3 (24.1)
Mean		8.3 (14.1)	5.9 (11.6)	4.3 (9.3)	11.5 (17.1)	

C.D. (p=0.05)
Treatments : 3.6
Intervals : 4.7

Figures in parentheses are arc sin $\sqrt{\text{percentage}}$ transformations

chilonis treatment was on a par with control. The damage to shed buds was significantly increased during the second half of August and there was no further increase in the subsequent periods.

The data presented in Table 2 revealed that damage in shed bolls appeared during first fortnight of August and then there was a significant increase in damage during second fortnight of August. Maximum damage in shed bolls was observed during first half of September which was on a par with second fortnight of September and first fortnight of October (Table 2).

The data presented in Table 3 revealed that number of bolls per plant in insecticide (47.2), insecticide + *T.chilonis* (46.3) and *T. chilonis* (38.8) treatments were on a par with each other and were significantly higher than in control (19.4). The loculi infestation was 47.5 per cent while in *T. chilonis, T. chilonis* + insecticides and insecticide treatments it was 30.2, 13.1 and 10.1 per cent respectively which were significantly lower than the control. The latter two treatments were on a par with each other. The same trend of damage was observed in open bolls. Yield was maximum (19.7 Q/ha) in insecticide treatment followed by *T. chilonis* + insecticide treatment (18.6 Q/ha) and *T. chilonis* treatment (12.1 Q/ha). The yield in control was only 8.6 Q/ha. The recovery tests indicated 60-70 per cent parasitism of *Earias* eggs by host exposure method in *T. chilonis* and *T. chilonis* + insecticide treatments. The recovery of *Trichogramma* from parasitoid colonized areas has also been reported by Awate *et al.* (1977) and Varma and Maninder (1983). The results support the findings of Brar *et al.* (1991) that *Trichogramma* releases we effective but were not superior to insecticide treatments.

The results of the present studies suggest that 8 releases of parasitoids + 5 sprays (3 against sucking pests and 2 against bollworms) were almost as effective as 7 sprays of insecticides (three against sucking pests and four against cotton bollworms). Further, the judicious integration of chemical control and egg parasitoids can reduce the number of sprays directed against cotton bollworms.

Table 2. Incidence of cotton bollworms in shed material in different treatments

Month	Fortnight	Shed buds attacked (%)					Shed bolls attacked (%)				
		T. chilonis	*T. chilonis* +5 sprays	Insecticide (7 sprays)	Control	Mean	*T. chilonis*	*T. chilonis* +5 sprays	Insecticide (7 sprays)	Control	Mean
Aug. 1991	I	70.3 (57.2)	63.2 (53.4)	59.7 (51.2)	74.4 (59.7)	66.9 (55.4)	0.0 (0.0)	8.3 (8.8)	25.0 (22.5)	0.0 (0.0)	8.3 (7.8)
	II	26.7 (27.4)	8.3 (8.8)	12.5 (11.3)	46.2 (46.3)	23.4 (23.4)	28.0 (31.5)	9.2 (12.7)	15.7 (20.3)	15.0 (19.6)	17.0 (21.0)
Sep.	I	35.1 (35.8)	16.7 (20.8)	28.8 (32.1)	13.3 (13.3)	23.5 (25.5)	40.4 (32.6)	18.7 (25.3)	24.0 (29.3)	15.8 (23.2)	22.2 (25.6)
	II	4.6 (4.2)	4.2 (6.0)	5.0 (6.6)	31.9 (34.1)	11.5 (12.7)	18.6 (25.4)	16.7 (24.0)	14.9 (22.5)	15.6 (23.1)	16.5 (23.8)
Oct.	I	33.3 (31.3)	25.0 (22.5)	8.3 (8.8)	25.0 (22.5)	22.9 (21.3)	28.5 (31.7)	14.7 (19.7)	6.5 (12.7)	23.1 (28.5)	18.2 (23.2)
Mean		24.3 (22.3)	16.8 (15.9)	16.3 (15.7)	27.3 (25.1)		15.1 (17.3)	9.7 (12.9)	12.3 (15.3)	9.9 (13.9)	

C.D. (p=0.05) Treatments 8.3
Intervals 11.0

Mean of 5 observations based on 1 m^2 qμ adrats

Figures in parentheses are arc sin $\sqrt{\text{percentage}}$ transformations

Table 3. Comparative efficacy of *Trichogramma chilonis* and insecticides in the control of cotton bollworms

Observations	*T. chilonis*	*T. chilonis* + 5 sprays	Insecticide (7 sprays)	Control	C.D. (p=0.05)
Bolls/plant*	38.8 (6.2)	46.3 (6.8)	47.2 (6.8)	19.4 (4.4)	(1.2)
Loculi infested (%)**	30.2 (33.0)	13.1 (20.4)	10.1 (17.8)	47.5 (43.7)	(8.3)
Open bolls infested (%)**	53.8 (47.2)	33.9 (35.0)	30.0 (31.7)	69.5 (58.4)	(10.8)
Yield (Q/ha)	12.1	18.6	19.7	8.6	-
Parasitoid Recovery (%) By Host Exposure Method					
September	65	60	0	0	
October	70	60	0	0	

Avg. of 5 repeats and each repeat consisted of 10 plants

* Figures in parentheses are $\sqrt{n}$ transformations

** Figures in parentheses are arc sin $\sqrt{\text{percentage}}$ transformations

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