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Evaluation of different strains of *Trichogramma chilonis* Ishii for the suppression of sugarcane early shoot borer, *Chilo infuscatellus* Snellen

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ABSTRACT: The efficacy of high temperature tolerant (PDBC strain) and Ludhiana (Punjab) strain of *Trichogramma chilonis* Ishii against early shoot borer *Chilo infuscatellus* Snellen was evaluated in farmers' field during 2004 and 2005. The PDBC strain was released from April to June @ 50000, 40000 and 30000 parasitoids / ha, and the Ludhiana strain @ 50000 parasitoids / ha. Nine releases of PDBC strain and Ludhiana strain @ 50000 parasitoids / ha were as effective as application of cartap hydrochloride (Padan 4G) @ 25 kg/ ha in reducing the incidence of *C. infuscatellus* by 52.7 and 50.5% over untreated control, respectively. At lower two doses, the reduction was 29.03 and 34.7 per cent over untreated control and was significantly better as compared to untreated control and mechanical control (removal of dead hearts). The maximum parasitoid recovery (10.71% parasitization) was recorded with PDBC strain @ 50,000parasitoids/ ha and was on par with Ludhiana strain (9.88% parasitization) and significantly higher than that with lower doses of PDBC strain and control. Based on reduced pest incidence, higher parasitism and yield, the releases of *T. chilonis* (PDBC strain / Ludhiana) @ 50000 parasitoids/ ha at 10 days interval from April to June can be successfully used for the suppression of early shoot borer.

KEY WORDS: *Chilo infuscatellus*, efficacy, strains, *Trichogramma chilonis*

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is one of the most important agro-industrial crops. Out of 211 species of insect reported to attack sugarcane in India, 18 are major and 21 are more minor pests, consisting of tissue borers, suckers and subterranean (David and Nandgopal, 1986). Among the tissue borers, early shoot borer, *Chilo infuscatellus* Snellen, is active from April to June, causing cane yield and sugar recovery loss of 33 and 12 per cent, respectively (Easwaramoorthy and Salin, 2002). In order to maintain the ecological balance as well as meet the demands of the international market, it will be of utmost importance to intensively incorporate biological control in the management of sugarcane pests. *Trichogramma chilonis* Ishii and other trichogrammatids are being

used against sugarcane borers in India and elsewhere in the world (Narayanan, 1933; Greenberg *et al.*, 1998; Singh and Jalali, 1994; Shenhmar *et al.*, 2005). Considering the high temperature in North India during summers when the activity of the borers is at its peak, the Project Directorate of Biological Control (PDBC), Bangalore has developed a high temperature tolerant (PDBC) strain of *T. chilonis* which was tested under Punjab condition to evaluate its efficacy in comparison with other treatments during 2004 and 2005 seasons.

MATERIALS AND METHODS

The studies on the evaluation of *T. chilonis* strains for the management of sugarcane early shoot borer were carried out by Biological Control Laboratory, Department of Entomology, Punjab Agricultural University at farmers' field located at village Haripur, Jalandhar (Punjab). The experiment was laid out in a randomized block design for two cropping seasons (2004 and 2005) in a plot of 0.4 ha (4000 sq. m. for each treatment) divided into four subplots to serve as replications with sugarcane variety CoJ 83 cultivated as per recommended agronomic practices. The PDBC strain of *T. chilonis* (able to tolerate 38±2°C) was procured from PDBC, Bangalore while, Ludhiana strain was maintained in the Biological Control Laboratory, Department of Entomology, PAU, Ludhiana from the field collected (sugarcane belt) parasitized eggs of early shoot borer of sugarcane during June. *Trichogramma chilonis* (Tricho cards 5.0 x 2.5 cm with 500 seven-day-old parasitized *Corcyra cephalonica* (Stainton) eggs) were released at 10 days interval by stapling uniformly to the underside of sugarcane leaves in each plot from April to June. The application rate of Ludhiana strain was 50000 parasitoids / ha while PDBC strain was released at three different doses of 30000, 40000 and 50000 parasitoids / ha. For mechanical control, easily pullable dead-hearts were removed at 15 days interval from mid-March to mid-June and for chemical control, 25 kg of cartap hydrochloride (Padan 4G) mixed in 20 kg of sand per hectare was applied at post-germination stage (45 days after planting) followed by slight earthing up and light irrigation. A distance of 10 m was kept between treatments to serve as buffer.

The damaged canes were counted from 4 units of 100 shoots each from each plot, i. e., 4 units of 25 shoots each from each subplot on the basis of dead hearts. The observations on the incidence were recorded once before start of parasitoid releases and at 10 days interval up to June. The yield of sugarcane was recorded on whole plot basis for all the treatments. For field recovery of parasitoid, as the collection of the borer eggs was negligible, sentinel cards glued with 100 fresh eggs of *C. cephalonica* were stapled on the underside of leaves in the field to observe parasitism from each treatment three times in each month. In each subplot, 3 cards were stapled on the day of release of the parasitoid and removed after 24 h. The cards removed from each treatment were kept in separate homeopathic glass vials (2 dram) in the laboratory to record the parasitism. Data were pooled and analyzed by one-way ANOVA and significance was determined by DMRT test for differences among treatments.

RESULTS AND DISCUSSION

The pre-treatment incidence during both years was very low (0.0 to 0.75%), therefore was omitted from the analysis. In May 2004, the highest mean incidence was recorded in control and was significantly higher than all other treatments. In mechanical control treatment, the incidence was significantly higher than that with PDBC strain @ 30000 parasitoids / ha, which was on par with PDBC strain @ 40000 parasitoids / ha (Table 1). Least incidence was recorded in PDBC and Ludhiana strains @ 50000 parasitoids/ ha and cartap hydrochloride, which were on par with each other. Similar trend was observed in May 2005 with least incidence recorded with cartap hydrochloride, PDBC and Ludhiana strain @ 50000 parasitoids/ ha. The pooled data for both years also revealed that releases of parasitoid strains @ 50000 parasitoids/ ha were on par with application of cartap hydrochloride and releases at 10-day interval were successful in checking the increase in borer incidence from April to June as compared to control (Fig 1).

Mean parasitism of sentinel *C. cephalonica* egg cards declined from April to June in all treatments during 2004 and 2005, which may be generally related to increase in temperature (Table 2). Based on pooled data of 2004, the highest parasitization *C. cephalonica* eggs was observed in plots where PDBC strain (10.45%) and Ludhiana strain (9.81%) were released @ 50000 parasitoids / ha. The per cent parasitism declined significantly as doses decreased and also in other treatments. Similarly the pooled data of 2005 revealed the maximum and significantly higher parasitization in PDBC and Ludhiana strain released plots @ 50000 parasitoids / ha and PDBC strain @ 40000 and 30000 parasitoids / ha were on par with each other, but significantly different compared to untreated control.

The cane yield in 2004 with releases of PDBC strain @ 50000 parasitoids / ha was on par with cartap hydrochloride, Ludhiana strain @ 50000 parasitoids / ha and PDBC strain @ 40000 parasitoids / ha (Table 3). Mean yield recorded in mechanical control was on par with control and PDBC strain @ 30000 parasitoids / ha. Similar trend was observed in 2005, but the lowest yield was recorded in control and mechanical control and it was significantly lower than all the other treatments. Overall mean yield for the two years was highest in cartap hydrochloride (568.8 q / ha) and it was on par with PDBC strain (566.8 q / ha) and Ludhiana strain (565.9 q / ha) and was significantly higher compared to lower dosages and other treatments. The maximum cost-benefit ratio was recorded with releases of PDBC strain @ 40000 parasitoids / ha (1: 11.25) followed by the same strain @ 50000 parasitoids / ha (1: 9.3).

These results are in accordance with those of Brar *et al.* (2002) reporting lowest mean incidence of the pest in the plots where *T. chilonis* was released @ 50000 / ha and Shenhmar *et al.* (2005) who reported that six to seven releases of *T. chilonis* at 10 days interval during April to June @ 50000 / ha

Table 1. Effect of releases of *Trichogramma chilonis* strains on incidence of *Chilo infuscatellus* during 2004 and 2005

Treatments	Dose / ha	Per cent incidence* of borer						Overall Pooled Mean
		2004			2005			
		May	June	Pooled Mean	May	June	Pooled Mean	
T. chilonis (Ludhiana strain)	50000	3.33^{a}	5.81^{a}	4.57^{a}	3.0^{a}	4.9^{a}	3.9^{a}	4.3^{a}
T. chilonis (PDBC strain)	30000	4.0^{cd}	8.4^{c}	6.2^{b}	3.9^{b}	8.1^{c}	6.0^{b}	6.1^{c}
T. chilonis (PDBC strain)	40000	3.8^{bc}	7.79^{b}	5.8^{b}	3.8^{b}	7.1^{b}	5.5^{b}	5.6^{b}
T. chilonis (PDBC strain)	50000	3.1^{a}	5.6^{a}	4.3^{a}	2.8^{a}	4.9^{a}	3.8^{a}	4.1^{a}
Cartap hydrochloride (Padan 4G)	25Kg	3.0^{a}	5.7^{a}	4.4^{a}	2.7^{a}	4.7^{a}	3.7^{a}	4.0^{a}
Mechanical control		4.8^{a}	9.4^{d}	7.1^{b}	5.0^{c}	8.3^{c}	6.7^{b}	6.9^{d}
Control		5.8^{d}	11.9^{e}	8.9^{c}	5.9^{d}	10.8^{d}	8.4^{c}	8.6^{e}

* Mean of three observations at 10-day interval in each month; Figures in parentheses are the arcsine transformed values; Figures in a column followed by the same alphabets are on par with each other

Table 2. Extent of parasitism of *Corcyra cephalonica* eggs following releases of high temperature tolerant and Ludhiana strains of *Trichogramma chilonis* for the control of *Chilo infuscatellus*

Treatments	Dose/ha	Per cent parasitism during different years*								Overall Pooled Mean
		2004				2005				
		April	May	June	Pooled Mean	April	May	June	Pooled Mean	
T. chilonis (Ludhiana strain)	50000	11.45 (20.21)	9.30 (18.24)	8.67 (17.61)	9.81[a]	12.09 (20.77)	9.94 (18.84)	7.79 (16.68)	9.94[a]	9.88[a]
T. chilonis (PDBC strain)	30000	4.73 (13.20)	3.76 (11.88)	3.48 (11.48)	3.99[c]	4.24 (12.47)	3.51 (11.53)	3.30 (11.21)	3.68[c]	3.84[c]
T. chilonis (PDBC strain)	40000	7.42 (16.33)	6.18 (14.97)	4.73 (13.18)	6.11[b]	8.45 (17.40)	6.88 (15.75)	4.57 (12.91)	6.63[b]	6.37[b]
T. chilonis (PDBC strain)	50000	11.88 (20.59)	10.60 (19.43)	8.88 (17.79)	10.45[a]	12.88 (21.44)	10.82 (19.65)	9.21 (18.13)	10.97[a]	10.71[a]
Control	-	0.52 (5.67)	0.00 (4.05)	0.45 (5.31)	0.32[d]	0.00 (4.05)	0.43 (5.27)	0.21 (4.74)	0.21[d]	0.27[d]
CD (P = 0.05)		(1.65)	(1.55)	(3.06)		(1.90)	(1.76)	(2.86)		

* Mean of three observations after each release of parasitoid in each month; figures in a column followed by the same alphabets are on par with each other as per DMRT test

Table 3. Effect of releases of high temperature tolerant and Ludhiana strains of *Trichogramma chilonis* on cane yield

Treatments	Dose/ha	Yield (q / ha)		Mean	Increase in yield over control	Cost benefit ratio
		2004	2005			
T. chilonis (Ludhiana strain)	50,000	562.5[a]	569.4[a]	565.9[a]	44.7	1: 8.9
T. chilonis (PDBC strain)	30,000	541.3[bc]	552.5[b]	546.9[b]	25.6	1: 6.4
T. chilonis (PDBC strain)	40,000	550.0[ab]	560.0[ab]	555.0[ab]	33.8	1: 11.3
T. chilonis (PDBC strain)	50,000	566.3[a]	567.5[a]	566.9[a]	45.6	1: 9.1
Padan 4G (Cartap hydrochloride)	25 Kg	566.3[a]	570.6[a]	568.4[a]	47.2	1: 4.7
Mechanical control	-	546.3[bc]	526.3[c]	536.3[bc]	15.0	1: 1.7
Control		528.8[c]	513.8[c]	521.3[c]		
CV		13.4	11.7	10.6	-	-

Figures in a column followed by the same alphabets are on par with each other as per DMRT; cost of Tricho-card with 20,000 parasitoid eggs is Rs. 30 / card; for mechanical control, two labours (Rs 100/ labour) are required to remove the dead heart one time; cost of Padan 4G – Rs. 55 / kg; cost of sugarcane @ Rs. 135 / quintal

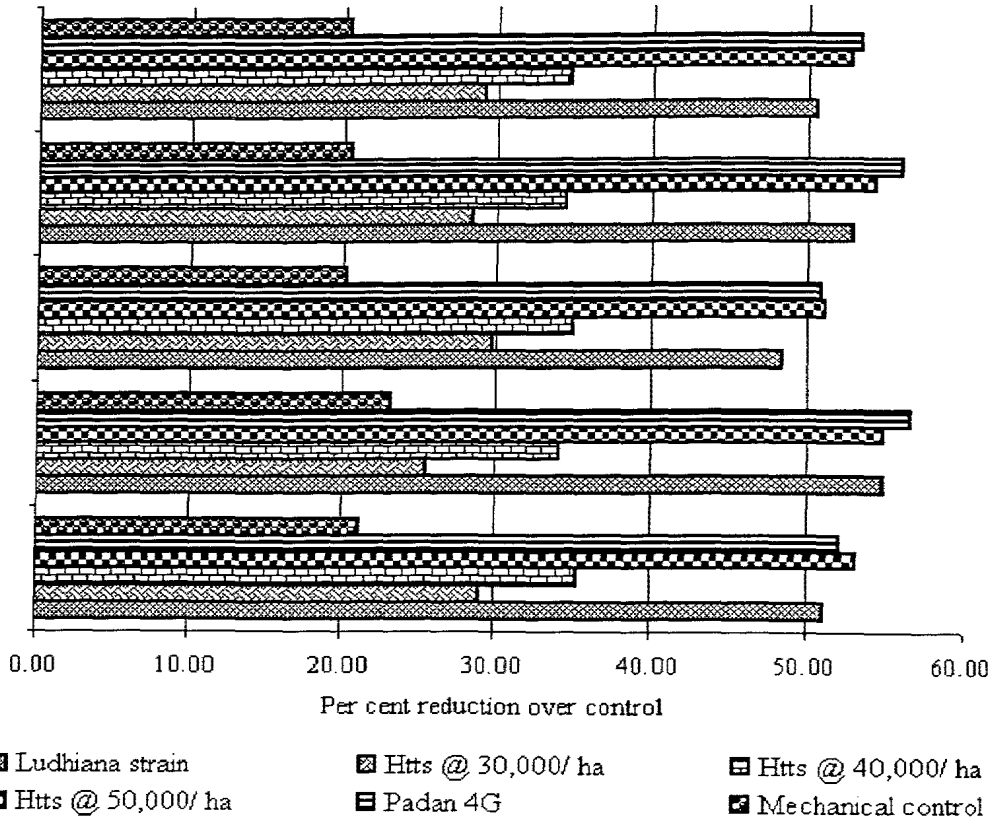

Fig. 1. Effect of different treatments on the reduction of *C. infuscatellus* incidence over control

reduced the incidence of *C. infuscatellus* by 53.1 per cent. Bhat *et al.* (2004) also reported that releases of *T. chilonis* remarkably reduced the incidence of *C. infuscatellus* by 82 per cent. Asharf *et al.* (1993) reported that the total release of 45 million *T. chilonis* resulted in the borer incidence between 4.2 to 6.8 per cent and Doomra *et al.* (1994) also reported lower (7.4%) incidence of borer in *T. chilonis* released plots as compared to control (16.4%). However, Gupta (1951) reported its releases were ineffective from April to July due to high temperature and low humidity.

This study demonstrated effectiveness of releases of temperature tolerant strains for the suppression of early shoot borer. Nine releases of parasitoid strains (PDBC strain @ 40000 parasitoids / 50000 parasitoids / ha / or Ludhiana strain @ 50000 parasitoids / ha) were as effective as chemical control and can be suitable alternatives to insecticides for the management of early shoot borer of sugarcane.

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