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Research Article

Validation of biocontrol technology for suppression of sugarcane top borer, *Scirpophaga excerptalis* (Fabricius) with *Trichogramma japonicum* Ashmead in Punjab

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ABSTRACT: The efficacy of *Trichogramma japonicum* released @ 50, 000 per ha at 10 days interval for the management of sugarcane top borer, *Scirpophaga excerptalis,* was validated at four locations in Punjab during 2009 and 2010. The mean incidence of top borer in *T. japonicum* released fields (6.2%) was at par with chemical control (5.8%) but lower than no release (control) (13.7%). The mean parasitism of eggs of *S. excerptalis* in released field was 32.1 per cent as compared to 2.5 percent in chemical control and 3.0 per cent in no release (control) plots. The mean yield in released plots (717.6 q/ha) and insecticide treated plots (725.1 q/ha), were significantly higher than the control plots (645.8 q/ha). The cost: benefit ratio for *T. japonicum* (1:21.5) was wider than for chemical control (1:6.8).

KEY WORDS: Sugarcane, biocontrol validation, *Scirpophaga excerptalis*, *Trichogramma japonicum*

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INTRODUCTION

Sugarcane (*Saccharum officinarum* Linnaeus) is an important agro-industrial crop of India. In Punjab, it is estimated to be grown over an area of 60 thousand hectares with an average yield of 676 q/ha during 2010-11 (Anonymous, 2011). Sugarcane is a long duration crop and many pests start infesting the crop right from sowing to harvesting (Sundara, 2001). Of the 211 species of insects reported to attack sugarcane, 18 are major pests which include tissue borers which often cause significant losses to the quality as well as quantity of the crop (David and Nandgopal, 1986). The more serious among them are early shoot borer, *Chilo infuscatellus* Snellen, stalk borer, *C. auricilius* Dudgeon and top borer, *Scirpophaga excerptalis* (Fabricius). Among these, top borer is active from April to October with five broods in the season. It can cause yield loss of 18.5 t/ha at 55 per cent incidence (Gupta, 1959) and 30 per cent loss when incidence is heavier (Rajani, 1960). Chemical control measures are available for top borer but are difficult to apply in grown up crops, while the repeated use of insecticides can also cause pest resurgence, secondary pest outbreaks, besides chemical residues in juice and sugar and pollution of the environment. Inundative releases of *Trichogramma japonicum* @ 50, 000 per ha have earlier been shown to be effective against top borer in research trials (Misra *et al.*, 1986; Shenhmar *et al.,* 2005; Singh *et al.*, 2006). However, it is important to validate their impact and economic benefit in linkage with farmers, as means of promoting the technology adoption. The present studies were, therefore, undertaken to validate the effectiveness of this biocontrol technology (inundative releases of *T. japonicum*) for the management of sugarcane top borer under field conditions with the involvement of farmers in selected locations.

MATERIALS AND METHODS

Large scale on-farm impact validation trials for the biocontrol technology (inundative releases of *T. japonicum*) against top borer, *S. excerptalis,* were carried out at village Jasso Majara and Mehli (Dist. Jalandhar) during 2009 and at Gohawar and Paddi khalsa (Dist. Kapurthala) during 2010, over an area of 40 hectares during each year. The parasitoid, *T. japonicum* was released 8 times at 10 days interval from April to June @ 50,000 per ha per release. It was compared with chemical insecticide application and untreated (no release) control. For chemical insecticide, phorate (Thimet 10G) @ 30kg/ha of the product was applied during first week of July as per recommendation of Punjab Agricultural University, Ludhiana (Anonymous, 2011). The plot size for chemical control and untreated control was 0.2 ha each, respectively. The incidence of top borer and yield was recorded from six locations in *T. japonicum* released fields whereas

chemical control and untreated control plots were divided into six parts to serve as six replications. The egg masses of *S. excerptalis* were collected as samples to record percent parasitisation in the laboratory. Data so obtained were statistically analyzed through ANOVA.

RESULTS AND DISCUSSION

2009 Trial:

The data presented in Table 1 revealed that the incidence of top borer in control plots was 13.0 and 12.2 per cent at Jasso Majara and Mehli respectively, and it was significantly higher than in *Trichogramma* released fields and chemical control plots. The incidence observed in *Trichogramma* released fields (5.7 to 5.9%) was at par with the levels in chemical control plots (5.3 to 5.5%). The mean incidence of top borer in control plot (12.6%) was also significantly higher than the values in release fields and chemical control. The mean incidence recorded in chemical control (5.5%) was at par with *T. japonicum* released fields (5.9%). The mean extent of reduction in incidence over control was 54.5 and 58.2 per cent in release fields and chemical control, respectively. The parasitism of eggs of *S. excerptalis* in released field was 24.4 and 35.4 per cent at Jasso Majara and Mehli, respectively. The mean parasitism of eggs of *S. excerptalis* in release field was 29.9 per cent as compared to 2.3 percent in chemical control and 2.9 per cent in no release-control plots (Table 1). The cane yield at both the location in the released field (730.3 and 691.5 q/ha) and chemical control (739.5 and 697.3 q/ha) was significantly higher than in control (647.5 and 624.8 q/ha). The yield in the former two treatments was at a par. The mean yield in control (636.1.3 q/ha) was significantly lower than in release fields (710.9 q/ha) and chemical control (718.4 q/ha), the latter two were at par with each other. The cost: benefit ratio in *T. japonicum* (1:22.7) was worked out as being higher than for chemical control (1:7.1).

2010 Trials:

The data presented in Table 2 revealed that the incidence observed in release field (6.2 to 7.1%) was at par with chemical control (6.1 to 6.4%). The incidence of top borer was 14.3 and 15.3 per cent in control at Gohawar and Paddi Khalsa, respectively and it was significantly higher than release fields and chemical control. The mean incidence recorded in chemical control (6.3%) was at par with *T. japonicum* released fields (6.7%) and the mean incidence of top borer in these two treatments was significantly lower than control (14.8%). Thus, the mean reduction in incidence over control was 53.1 and 57.8 per cent in release fields and chemical control, respectively. The parasitism of eggs of *S. excerptalis* in release field was 30.2 and 38.4 per cent at Gohawar and Paddi Khalsa, respectively. The mean parasitism of eggs of *S. excerptalis* in release field was 34.3 per cent as compared to 2.7 percent in chemical control and 3.1 per cent in control (Table 2). The cane yield at both the locations in released field (746.4 and 702.0 q/ha) and for chemical control (752.8 and 710.6 q/ha) was at par, but significantly higher than in control (647.5 and 624.8 q/ha). The mean yield in control treatment (655.4 q/ha) was significantly lower than in release fields (724.2 q/ha) and chemical control (731.7 q/ha), the latter two being at par with each other. The cost benefit ratio for *T. japonicum* release (1:20.6) was higher than for chemical control (1: 6.5).

The pooled data of two years (2009 and 2010) revealed that the mean incidence of top borer in control (13.7%) was significantly higher than releases and chemical control (Table 3). The incidence recorded in chemical

Table 1. Large scale demonstration of *Trichogramma japonicum* against *Scirpophaga excerptalis* at village Jasso Majara and Mehli (Dist. Jalandhar) in Punjab during 2009

Treatments	Incidence of *Scirpophaga excerptalis* (%)			Per cent parasitism				Yield (q/ha)			Cost: Benefit ratio
	Jasso Majra	Mehli	Mean	Jasso Majra	Jasso Majra	Mehli	Mean	Jasso Majra	Mehli	Mean	
T. japonicum	5.5 (13.14)	5.9 (13.86)	5.7 (13.78)	57.4	24.4 (28.22)	35.4 (36.14)	29.9 (31.86)	730.3	691.5	710.9	1:22.4
Phorate 10G @30kg/ha	5.0 (12.76)	5.5 (13.32)	5.3 (12.92)	61.2	2.2 (7.56)	2.4 (7.62)	2.3 (7.60)	739.5	697.3	718.4	1:7.1
Control	13.0 (20.94)	12.2 (20.18)	12.6 (20.42)		3.0 (8.11)	2.8 (7.94)	2.9 (8.08)	647.5	624.8	636.1	
CD (*P*=0.05)	(2.14)	(3.82)	(2.64)		(2.54)	(4.16)	(3.24)	12.28	14.72	13.92	

Figures in parentheses are angular transformed values.

Table 2. Large scale demonstration of *Trichogramma japonicum* against *Scirpophaga excerptalis* at village Gohawar and Paddi khalsa (Dist. Jalandhar) in Punjab during 2010

Treatments	Incidence of *Scirpophaga excerptalis* (%)			Yield (q/ha)			Cost: Benefit ratio			
	Gohawar	Paddi khalsa	Mean	Gohawar	Paddi khalsa	Mean	Gohawar	Paddi khalsa	Mean	
T. japonicum	6.2 (14.14)	7.1 (15.22)	6.7 (14.79)	30.2 (32.52)	38.4 (37.96)	34.3 (35.86)	746.4	702.0	724.2	1:20.6
Phorate 10G @30kg/ha	6.1 (13.96)	6.4 (14.78)	6.3 (14.41)	2.8 (7.92)	2.6 (7.68)	2.7 (7.82)	752.8	710.6	731.7	1:6.5
Control	14.3 (22.24)	15.3 (23.28)	14.8 (22.88)	3.0 (8.28)	3.2 (8.42)	3.1 (8.34)	678.8	632.0	655.4	
CD (*P*=0.05)	(1.98)	(2.84)	(2.54)	(3.22)	(5.28)	(4.86)	10.28	14.20	11.86	

Figures in parentheses are angular transformed values.

Table 3. Large scale demonstration of *Trichogramma japonicum* against *Scirpophaga excerptalis* during 2009 and 2010 (pooled)

Treatments	Incidence of *Scirpophaga excerptalis* (%)	Per cent parasitism	Yield (q/ha)	Cost: Benefit ratio
T. japonicum	6.2 (14.28)	32.1 (34.21)	717.6	21.5
Phorate 10G @30kg/ha	5.8 (13.74)	2.5 (7.98)	725.1	6.8
Control	13.7 (21.52)	3.0 (8.18)	645.8	
CD (*P*=0.05)	(1.24)	(4.28)	21.2	

Figures in parentheses are angular transformed values.

control (5.8%) was at par with *T. japonicum* release fields (6.2%). The mean parasitism of eggs of *S. excerptalis* in release field was 32.1 per cent as compared to 2.5 percent in chemical control and 3.0 per cent in control. The yield in control (645.8 q/ha) was significantly lower than release fields (717.6 q/ha) and chemical control (725.1 q/ha), the latter two were at par with each other. The cost benefit ratio for *T. japonicum* (1:21.5) was higher than for chemical control (1:6.8).

It can be concluded from the pooled analysis data that the 8 releases of *T. japonicum* @ 50,000 per ha at 10 days interval made from April to June reduced the incidence of top borer overall by 54.7 per cent. The cost: benefit ratio of *Trichogramma* release field (1:21.5) was economically favorable than for chemical control (1:6.8) (Table 3). The present findings are in agreement with those of Misra *et al.* (1986),who tested the releases of *T. japonicum* over 100 ha @ 50, 000 per ha per week, which proved to be very effective against top borer. This is also in conformity with the results obtained with the release of *T. japonicum* against top borer on sugarcane by several other workers (Doomra *et al.,* 1994; Shenhmar and Brar, 2003; Shenhmar *et al.,* 2005; Singh *et al.*, 2006).

The present results have confirmed the on-farm benefits of *Trichogramma* releases for sugarcane top borer management in Punjab conditions with a release régime of 50,000 adults/ha, repeated 8 times.

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