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Research Note

Effect of inundative releases of *Trichogramma chilonis* in sugarcane

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ABSTRACT: Studies on effect of inundative releases of *Trichogramma chilonis* in sugarcane revealed that the frequency and rate of *T. chilonis* release had played a significant role in the management of sugarcane shoot borers. Early shoot borer and internode borer incidence was low in *T. chilonis* @ 75,000/ha/release, 6 times (6.54% and 2.27% ; 3.92% and 5.85%) followed by *T. chilonis* @ 50,000/ha/release, 6 times (7.9% and 4.26%) whereas untreated control recorded high incidence of early shoot borer and internode borer (10.94% and 15.95 %; 5.12% and 18.25 %) during 2015 and 2016. The sustainability of inundative releases of *T. chilonis* with highest per cent field recovery was recorded in *T. chilonis* release @75,000/ha/release, 6 times during monsoon period (68.63% and 20%) and post monsoon period (29.55% and 37.59 %) as compared to pre monsoon period (12.1% and 9.27 %) of 2015 and 2016. Cane yields recorded in plant crop, 2015 (52.42 t/ha) and ratoon crop, 2016 (47.95 t/ha) revealed that high rate of *T. chilonis* @ 75,000/ha/release resulted in increased yields (21.77 % and 24.64 %) over untreated control.

KEY WORDS: Field recovery, inundative releases, *Trichogramma chilonis*

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INTRODUCTION

Sugarcane shoot borers have become challenging pests of sugarcane crop due to their feeding habit inside the plant parts where sprays are difficult to reach. Indiscriminate use of pesticides results in mortality of natural enemies resulting in flare up of pest population. Inundative releases of the bioagents for the control of lepidopterous pests are being practiced in more than 32 million hectares each year around the world. *Trichogramma chilonis* release reduced the damage up to 70-92% on sugarcane, corn and cotton crops in China, Switzerland, Canada. Narasimha Rao *et al.* (2006) reported that four releases of *T. chilonis* @ 50,000/ ha/release from 30 days after planting at 7-10 day interval were effective in borer management in sugarcane. Biological control of early shoot borer, *Chilo infuscatellus* (Snellen) and internode borer, *Chilo sacchariphagus indicus* (Kapur) in sugarcane through inundative releases of the egg parasitoid, *T. chilonis* Ishii is being practiced in sugarcane cultivated tracts in India and it has also received considerable attention in Andhra Pradesh. Many pests proliferate during specific seasons with natural enemies co-occurring. Early shoot borer attacks the crop in its early stages of growth with peak activity during summer months. The pest infestation is generally high during pre-monsoon period (April-June) when high temperature prevails and its activity decreases with the onset of south west monsoon. Internode borer attack is more in the monsoon and post monsoon periods. Several reports are available on the varied degree of parasitism (2-95%) by *Trichogramma* spp. after release. However, information is sparse on the recovery of the parasitoids in sugarcane ecosystem. Effective dispersal distance was studied based on the recovery of *T. chilonis* in sugarcane. Hence, it is highly essential to study the feasibility of inundative releases of *T. chilonis* against sugarcane shoot borers.

MATERIALS AND METHODS

Field experiments were conducted at Regional Agricultural Research Station, Anakapalle using sugarcane variety 2001A56 during 2015-16 planted crop during April 2015 and during 2016-17 ratoon crop planted in April 2016 to study the effect of inundative releases of *T. chilonis* recommended for management of shoot borers infesting sugarcane in Andhra Pradesh. The Biocontrol agent, *T. chilonis* (National accession no. NBAII-MP-TRI-13) supplied by NBAIR, Bangalore was multiplied in the Biocontrol Laboratory, AICRP on Biological control, Regional Agricultural Research Station, Anakapalle, Andhra Pradesh. *Trichogramma chilonis* was released at two rates of release, *i.e.*, 50,000/ha/week and 75,000/ha/week. The number of releases was 4 and 6 from 30 days after planting and two at node formation in different blocks. The unreleased experimental block was treated as control. Egg cards

(10 cm x 2.5 cm) containing *T. chilonis* parasitized eggs were cut into small pieces and placed uniformly in each block at 30 days after planting for adequate dispersal of the parasitoid. The subsequent releases were made at weekly intervals.

There were four treatments as blocks with different dosages and timing of *T. chilonis* release as Block 1: Release of *T. chilonis* @ 50,000/ha/week, 4 times from 30 Days After Planting (DAP) and two times at node formation at 7-10 day interval; Block 2: Release of *T. chilonis* @ 50,000/ha/week, 6 times from 30 (DAP) and two times at node formation at 7-10 day interval; Block 3: Release of *T. chilonis* @ 75,000/ha/week, 4 times from 30 DAP and two times at node formation at 7-10 day interval and Block 4: Release of *T. chilonis* @ 75,000/ha/week, 6 times from 30 DAP and two times at node formation at 7-10 day interval with Block 5: No release of *T. chilonis* as untreated control with five replications. Data on cumulative incidence of early shoot borer as % Dead Heart (DH) was recorded from 45 days to 120 days after planting. Percent incidence of internode borer was recorded from 10 randomly selected canes from each replication in all the blocks at harvest. The establishment of the parasitoid in sugarcane ecosystem was assessed on the basis of occurrence of early shoot borer damage as dead hearts during crop growth period and internode damage at harvest in all blocks with *T. chilonis* release at different rates and frequencies.

The field recovery of the parasitoid was studied by using *Corcyra* egg cards as sentinel cards as stem borer eggs were not available in the field abundantly throughout the year for studying the field recovery of the egg parasitoid, *T. chilonis*. *Corcyra* egg cards of 100 eggs as sentinel cards were kept in the field at a distance of one metre from the point of release after a day of *T. chilonis* release in five replications of all the blocks/treatments. Recovery of field populations of *T. chilonis* was assessed during premonsoon period (April, June), monsoon period (July) and post monsoon period (September, October) during 2015-16 and 2016-17. The field recovery of the parasitoid and cane yield increase over untreated control was calculated.

RESULTS AND DISCUSSION

Data on early shoot borer (ESB) and internode borer (INB) damage along with field recovery of *Trichogramma chilonis* during 2015 and 2016 are presented in Table 1 and 2.

During 2015, the data on early shoot borer damage (%DH) and internode borer damage (%) revealed that the releases of *T. chilonis* had played a significant role in the reduction of shoot borers in sugarcane (Table 1). Block 4 recorded significantly lower per cent dead heart (6.54) and internode borer damage (3.92) followed by block 3 (7.62 and 4.21) indicating that the parasitoid establishment was good with higher dosage and more number of releases. Whereas, untreated control block recorded the highest per cent DH (16.6%) and internode borer damage (8.62%). Similar results were recorded during 2016, which showed that lowest per cent dead heart (2.27) and inter node borer damage (5.85) was observed in Block 4 and highest per cent in untreated control (15.95 %DH and 18.25%) (Table 2).

The highest per cent recovery of egg parasitoid, *T. chilonis* in block 4 during monsoon period (July, 2015 – 68.63%) ; post-monsoon period (September, 15–29.55%) and pre-monsoon period (June,15-12.1%) compared to other blocks indicated that the establishment of parasitoid was high in block 4 due to release of parasitoid at higher dosage and frequency. Higher recovery rate of *T. embryophagum* was recorded during October and November months in Taiwan corn fields infested by Asian corn borer (Bing & Jih, 1996). Jalali and Singh (2006) reported that natural enemies like *T. chilonis* can perform effectively in areas where the temperature ranges between 18° and 32°C rather than in other areas. Parasitoid recovery was low in block 1 during monsoon period (June, 2015 – 2.89%) and post-monsoon period (July, 15-4.13 and in September, 15–2.07%) and was negligible in control block (0.0- 0.43%) during monsoon and post-monsoon periods. Similarly, the highest per cent recovery of the parasitoid was in block 4 during post-monsoon period (October, 16), where highest percent recovery (37.59%) was recorded probably due to better establishment of the parasitoid compared to pre-monsoon (June, 16 – 9.27%) and monsoon periods (June, 16 –17.47% and July, 16 -20%). Significantly higher parasite recovery during post-monsoon period of crop (Grand growth stage) was in blocks treated with 6 releases of *T. chilonis* @ 75,000/ha/release from 30 days after planting and 2 times at node formation at weekly interval during both the years of study. Similar results reported that the variation in per cent recovery of parasite during the two years of study could be due to combined effect of climatic factors and plant physical factors which changes with the stage of the crop. The major climatic factors that determine the activity of any insect are temperature, relative humidity and rainfall (O'Malley, 2005). Somchoudhury and Dutt (1980) reported that mild climatic conditions were most favourable for *T. chilonis* (=*australicum* Girault) and *T. perkinsi* Girault resulting in significant increase in their parasitizing ability (Bing & Jih, 1996). Similar results indicated that dry season favourable for establishment and recovery of *T. chilonis* in paddy varieties (Das, 2004). Jalali *et al*. (2006a) worked on adaptive performance of *T. chilonis* at low temperature (18°-24°C) and reported that a strain adapted to low temperature parasitized 58% of *Corcyra cephalonica* eggs

Table 1. Relative percentage of *Trichogramma chilonis* recovered from egg masses of sentinel cards during 2015

Treatment	ESB (% DH)	INB damage (%)	*T. chilonis* field recovery (%)			Cane yield (t/ha)	Yield Increase (%)
			Pre-monsoon period 2015	Monsoon period 2015	Post-monsoon period 2015		
			First week June	Last week July	Last week Sep-tember		
T1: *T. chilonis* release @ 50,000/ha/release, 4 times from 30 days after planting and 2 times at node formation at weekly interval	10.94[b]	5.12[b]	2.89 (1.836)[a]	4.13[c]	2.07 (2.55)[c]	48.46[c]	12.57
T2:*T. chilonis* release @ 50,000/ha/release,6 times from 30 days after planting and 2 times at node formation at weekly interval	7.9[c]	4.26[b]	3.1 (1.836)[b]	48.92[b]	14.66 (3.891)[bc]	49.22[b]	14.33
T3:*T. chilonis* release @ 75,000/ha/release, 4 times from 30 days after planting and 2 times at node formation at weekly interval	7.62[c]	4.21[b]	6.32 (1.836)[c]	53.3[b]	19.86 (4.508)[ab]	50.0[b]	16.14
T4:*T. chilonis* release @ 75,000/ha/release, 6 times from 30 days after planting and 2 times at node formation at weekly interval	6.54[c]	3.92[b]	12.1 (1.836)[c]	68.63[a]	29.55 (5.475)[a]	52.42[a]	21.71
T5:Untreated control	16.6[a]	8.62[a]	0.0 (1.836)[d]	0.43[c]	0.0 (0.707)[d]	43.05[c]	
CD (*P*=0.05)	2.485	1.849	0.167	27.28	1.374	2.086	
CV%	18.68	26.368	5.868	52.06	29.91	5.04	

Values in parentheses are square root transformations; Mean values marked with same alphabets are significantly not different; ESB: Early shoot borer; INB: Internode borer; DH: Dead-heart

compared with 17.2% by the non- adaptive strain in an insect cage study. Tests indicated that adaptation to low temperatures led to better host searching and such strain could be successfully utilized under a low temperature regime. Effect of releasing *T. chilonis* on yield of sugarcane was significant between treatments *i.e. T. chilonis* releases at different rates and frequency during 2015 and 2016. The results showed that 6 releases of *T. chilonis* @ 75,000/ha/week, starting from 30

Table 2. Relative percentage of *Trichogramma chilonis* recovered from egg masses of sentinel cards during 2016

Treatment	ESB (%DH)	INB damage (%)	*T. chilonis* field recovery (%)				Cane yield (t/ha)	Yield In-crease (%)
			Pre-monsoon period 2016	Mon-soon period 2016	Post-monsoon period 2016			
			First week June	Last week June	Last week July	Third week October		
T1: *T. chilonis* release @ 50,000/ ha/release, 4 times from 30 days after planting and 2 times at node forma-tion at weekly interval	4.62[b]	7.77[b]	6.29 (2.605)[b]	4.43[c]	1.74[d]	25.88[c]	40.21[cd]	4.52
T2: *T. chilonis* release @ 50,000/ ha/release, 6 times from 30 days after planting and 2 times at node forma-tion at weekly interval	3.64[c]	7.81[b]	5.88 (2.525)[c]	5.17[b]	3.85[c]	33.85[b]	40.92[bc]	6.37
T3: *T. chilonis* release @ 75,000/ ha/release, 4 times from 30 days after planting and 2 times at node forma-tion at weekly interval	3.16[c]	7.28[b]	6.38 (2.622)[b]	4.75[bc]	10.88[b]	36.6[a]	42.48[b]	10.42
T4: *T. chilonis* release @ 75,000/ ha/release, 6 times from 30 days after planting and 2 times at node forma-tion at weekly interval	2.27[d]	5.85[c]	9.27 (3.125)[a]	17.47[a]	20.0[a]	37.59[a]	47.95[a]	24.64
T5: Untreated control	15.95[a]	18.25[a]	0.0 (0.707)[d]	0.88[d]	0.98[d]	1.10[d]	38.47[d]	
CD (*P*=0.05)	0.714	0.759	0.074	0.644	0.916	1.221	2.038	
CV%	8.986	6.026	2.368	7.346	9.07	3.37	3.619	

Values in parentheses are square root transformations; Mean values marked with same alphabets are significantly not different; ESB: Early shoot borer; INB: Internode borer; DH: Dead-heart

(DAP) and two times at node formation at 7-10 day interval effectively reduced shoot borers and increased cane yields by 21.7% during 2015-16 (yield 52.42 t/ha) and 24.64% during 2016-17 (yield 47.95 t/ha) as compared to control (43.05 t/ha during 2015 and 38.47 t/ha during 2016). Similar studies conducted at Jorhat, on rice against stem borer and leaf folder revealed that the release of *T. japonicum* during dry season played a significant role in the reduction of stem borer (Das, 2004).

Inundative releases of *T. chilonis* @ 75,000/ha/release, 6 times from 30 days after planting and 2 times at node formation stage at weekly intervals proved to be the best treatment followed by *T. chilonis* @ 75,000/ha/release 4 times from 30 days after planting and 2 times at node formation stage at weekly intervals, for managing early shoot borer and internode borer in sugarcane. Weather conditions prevailing during monsoon period and post monsoon periods are favourable for the sustainability of the parasitoid compared to pre monsoon period. Efficacy of *Trichogramma* in the field vary with the timing of release, frequency and rate of release and the performance is influenced by weather conditions, stage of the crop and host insect . Natural enemies generally closely follow the pest population in a stable crop system like sugarcane. Thus, Crop- pest- natural enemy equilibrium should be given due consideration in planning control measures. The stable crop system and low pesticide load provide ideal conditions for both natural and applied biological control.

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