



Research Article

Efficacy of egg parasitoid in management of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenée

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ABSTRACT: The relative efficacy of *Trichogramma chilonis* (Ishii) was evaluated for management of the brinjal shoot and fruit borer in the field condition at the Horticulture Farm of Rajasthan College of Agriculture, MPUAT, Udaipur from July 2016 to February 2017. The result showed that when three dosages of egg parasitoid, *T. chilonis* applied with 6 and 8 times releases @ 50000, 100,000 and 150,000 parasitized eggs at 10 days interval starting from 15 days after transplanting, releases of 150,000 for 6 and 8 times was found to be most effective with mean shoot damage of 11.96 and 12.66 per cent, respectively, while, the least effective rate was when parasitoid was released @ 50000/ha (T2 and T1) with mean shoot damage of 17.78 and 18.12 per cent, respectively, against fruit borer damage. Six and eight times release of *T. chilonis* @ 150,000 was most effective with mean fruit damage of 11.67 and 9.80 per cent on number basis, and 11.59 and 9.90 per cent per cent fruit damage on weight basis. The results revealed that the maximum parasitism was recorded for treatments of 8 and 6 times @ 150,000/ha (47.61 per cent to 47.05 per cent).

KEYWORDS: Barrier crop, brinjal, egg parasitoid, *Leucinodes orbonalis*, sorghum, *Trichogramma chilonis*

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INTRODUCTION

Brinjal (*Solanum melongena* L.: Solanaceae), also known as egg plant, is native to Indian sub-continent and is an important vegetable crop grown throughout the world. It has several vernacular names, viz., aubergine, baingan, badone, kausi, vangi, and vazhuthana. Brinjal is highly productive and usually known as men crop. It is a rich source of minerals (calcium, magnesium, phosphorus, sodium, potassium, chlorine and iron), vitamins, besides, having some medicinal importance (Choudhary, 1967). The crop is reported to be infested by 26 species of insect pests and mites throughout the season (Vevai et al., 1970); among these, the fruit and shoot borer, *Leucinodes orbonalis* Guenée; jassid, *Amrasca biguttula biguttula* (Ishida); aphid, *Aphis gossypii* (Glover); lace wing bug, *Urentius echinus* (Distant); epilachna beetle, *Epilachna vigintioctopunctata* (Fab.); whitefly, *Bemisia tabaci* (Gennadius.) and stem borer, *Euzophera perticella* Ragonot are major constraints in achieving potential yield, besides, some of them remain active throughout the year with many overlapping generations. Crop losses have been reported to the tune of 20-89 per cent in various parts of

country by this pest (Raju et al., 2007). The larvae of the pest bore into petioles and midribs of the large leaves or young growing shoots, close the opening with their excreta and feed within. In the later stages of plant, it bores into flowers, buds and fruits entering from under the calyx having no visible sign of infestation and feed inside the fruits. The infested fruits lose their market value and finally complete loss occurs.

The bio-control agents naturally occurring in the environment can associate with the different life stages of brinjal shoot and fruit borer and have the capability to maintain the pest population under equilibrium condition Natarajan (2005) and Srinivasan (2008). At this juncture the parasitism ability of egg parasitoid, *Trichogramma chilonis* Ishii on the eggs of *L. orbonalis* was investigated in order to recommend it as a suitable biocontrol agent for *L. orbonalis*.

MATERIALS AND METHODS

The experiment was carried out at the Horticulture Farm of Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India, during *kharif* (July 2016 to February 2017).

Geographically, Udaipur is located at 23.4°N longitude and 75°E latitude at an elevation of 579.5 MSL in the state of Rajasthan, India. The experiment was laid out on the treatment comprised 6 and 8 times releases of egg parasitoid, *T. chilonis* @ 50000, 100,000 and 150,000/ha released at 10 days interval starting from 15 days after transplanting. There were 7 treatments including the control. Each treatment was replicated thrice times.

Treatments	Doses of <i>T. chilonis</i> parasitized egg
T1	6 release – @ 50,000 eggs/ ha.
T2	8 release – @ 50,000 eggs/ ha.
T3	6 release – @ 100,000 eggs/ ha.
T4	8 release – @ 100,000 eggs/ ha.
T5	6 release – @ 150,000 eggs/ ha.
T6	8 release – @ 150,000 eggs/ ha.
T7	(no release)

The field experiment was laid out in Randomized Block Design (RBD) and each treatment was replicated three times. The brinjal variety “Shashi (040)” was used for the experiment. Five plants were randomly selected and tagged from each plot. The egg parasitoid was released through trichocard. Brinjal was sown under field conditions in which spacing was provided by keeping plant to plant distance of 45 cm and row to row distance of 60 cm. The borer infested and healthy shoot and fruits of individual plots were sorted out after each picking and the numbers of infested and marketable fruits were recorded. The total number of infested shoot were recorded on one day prior to release and on 5th, 7th day after treatments and the mean value of each release was computed on the basis of cumulative data of all the pickings. Fruit infestation was also recorded on 5th and 7th days of both released after picking of fruits on number and weight basis and the total yield of uninfected fruit in each treatment was also computed. The mean per cent infestation in shoots and fruits damage were subjected to statistical analysis after angular transformation.

Parasitism efficiency of *T. chilonis* on *L. orbonalis* One-day, two-day and three-day old eggs of *L. orbonalis* were collected from the laboratory cultures of *L. orbonalis*. The number of eggs in each cotton cloth used for egg laying by *L. orbonalis* was counted and placed in a polyethylene cover. Based on the number of eggs of *L. orbonalis*, the adults of *T. chilonis* were collected from the laboratory cultures at the rate of 6: 1 by aspirator and eggs of *L. orbonalis* was placed into a new polyethylene cover and carefully tied. The observations were continued until the emergence of parasitoids.

Bio-agent efficacy for management of shoot and fruit borer

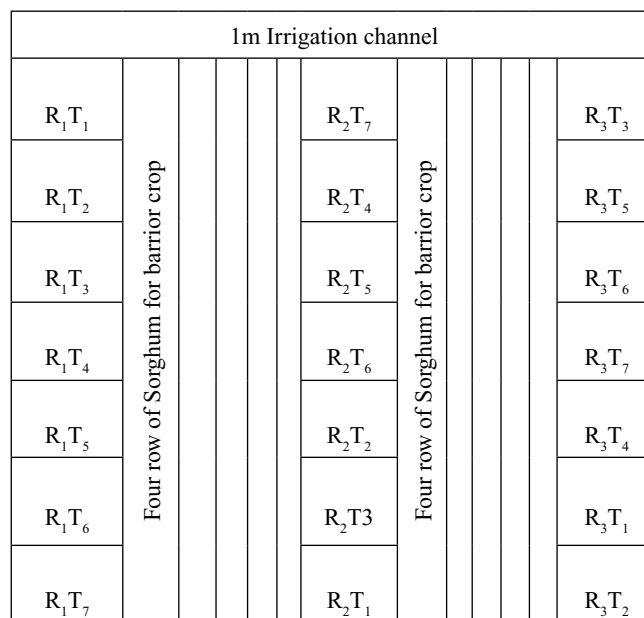


Fig. 1. Total area of bio-agent efficacy: 212.4m² one plot Size 3m x 2.7m.

Statistical analysis

The data on percentage infestation of brinjal fruits by borer was calculated at each picking by counting damage and healthy fruits in each treatment. The mean per cent fruit damage was calculated using formula:

$$\text{Mean fruit damage (\%)} = \frac{\text{Number of damaged fruits}}{\text{Total number of fruits}} \times 100$$

The economics of different treatments was calculated by taking into consideration the cost of application of different treatments and prevailing market price of brinjal. The total marketable fruit yields obtained from all plots were computed on hectare basis. The increase in fruit yield was calculated as yield in treated plots compared to untreated plots as follows:

$$\text{Per cent increased yield} = \frac{\text{Increase yield in treated plot}}{\text{Yield in untreated plot}} \times 100$$

Cost benefit ratio was calculated by deducting the cost of egg parasitoids release from price of increased yield over control by using following formula:

$$\text{B:C ratio} = \frac{\text{Returns in treatment (Rs/ha)}}{\text{Return in control (Rs/ha) - cost of egg parasitoids and labour (Rs/ha)}}$$

RESULT AND DISCUSSION**Mean infestation (%) of *Leucinodes orbonalis* as shoot borer of brinjal**

Trichogramma chilonis release @ 150,000 /ha exhibited minimum mean shoot damage of 11.96 and 12.66 per cent, whereas, when released @ 50000 /ha was least effective with mean shoot damage of 17.78 and 18.12 per cent, however per cent shoot damage in untreated control was 22.27 per cent. After seven days of release, the order of efficacy remained the same and *T. chilonis* release @ 150,000 /ha exhibited minimum mean shoot damage of 12.04 and 12.93 per cent, followed by *T. chilonis* release @ 100,000 /ha, with 15.44 and 15.98 per cent mean shoot damage, respectively. *T. chilonis* release @ 50000 /ha was least effective with mean shoot damage of 18.06 and 18.52 per cent, as against 23.41 per cent in untreated control (Table 1).

Mean infestation on the number basis (%) of *Leucinodes orbonalis* on brinjal fruits

Trichogramma chilonis releases @ 150,000 /ha exhibited minimum mean fruit damage of 9.80 per cent. *T. chilonis* @ 50000 /ha was least effective with mean fruit damage of 16.10 per cent, as against 22.24 per cent in control. After seven days of release, the

order of efficacy remained the same and the parasitoid releases at 150,000 /ha exhibited minimum mean fruit damage of 10.01 per cent, followed by the releases @ 100,000 /ha, with 13.41 per cent mean fruit damage and the parasitoid releases @ 50000 /ha was least effective with mean fruit damage of 16.48 per cent whereas in control the damage was 20.84 per cent (Table 2).

Mean infestation (%) of *Leucinodes orbonalis* on fruits of brinjal on the weight basis

Similarly, *T. chilonis* releases @ 150,000 /ha exhibited minimum mean fruit damage of 9.76 per cent, followed by the releases @ 100,000 /ha with 13.08 per cent mean fruit damage, and releases @ 50000 /ha was least effective with mean fruit damage of 16.02 per cent, as against 19.70 per cent in control (Table 3).

Parasitism by *Trichogramma chilonis* of *Leucinodes orbonalis*

The results revealed that the maximum Parasitism of 47.61 and 47.05 was recorded for treatments when parasitoids were released @ 150,000 eight and six times, whereas, the minimum parasitism of 30.3 and 26.66 per cent was recorded for treatments where parasitoids were released @ 50,000 / height and six times release (Table 3).

Table 1. Influence of egg parasitoid *Trichogramma chilonis* on the BSFB infestation as shoot borer during *kharif* 2016-17

Treatments	Dose release@ /ha	Mean (%) shoot infestation on days of release								
		1 st Release			2 nd Release		3 rd Release		4 th Release	
		PRP	5DAR	7 DAR	5 DAR	7 DAR	5 DAR	7 DAR	5 DAR	7 DAR
T1	6 Releases @ 50,000/ha	20.11 (26.64)	19.36 ^c (26.08)	19.51 ^c (26.21)	19.30 ^c (26.06)	19.35 ^c (26.09)	18.69 ^c (25.61)	18.94 ^c (25.80)	18.12 ^b (25.19)	18.52 ^c (25.49)
T2	8 Releases @ 50,000/ha	19.34 (26.09)	19.04 ^c (25.87)	19.15 ^b (25.95)	18.99 ^c (25.83)	19.08 ^c (25.90)	18.21 ^c (25.26)	18.47 ^b (25.45)	17.78 ^b (24.91)	18.06 ^b (25.14)
T3	6 Releases @ 100,000/ha	18.09 (25.16)	16.48 ^b (23.93)	16.72 ^b (24.13)	16.35 ^b (23.84)	16.41 ^b (23.88)	16.05 ^b (23.60)	16.37 ^b (23.86)	15.86 ^b (23.46)	15.98 ^b (23.56)
T4	8 Releases @ 100,000/ha	17.06 (24.39)	16.34 ^b (23.82)	16.44 ^b (23.89)	16.01 ^b (23.57)	16.34 ^b (23.83)	15.45 ^b (23.14)	15.95 ^b (23.52)	15.10 ^a (22.84)	15.44 ^b (23.13)
T5	6 Releases @ 150,000/ha	16.48 (23.94)	13.44 ^a (21.50)	13.77 ^a (21.75)	13.35 ^a (21.40)	13.47 ^a (21.52)	13.02 ^a (21.14)	13.42 ^a (21.48)	12.66 ^a (20.83)	12.93 ^a (21.06)
T6	8 Releases @ 150,000/ha	18.35 (25.35)	12.94 ^a (21.07)	13.06 ^a (21.16)	12.84 ^a (21.00)	12.92 ^a (21.03)	12.39 ^a (20.60)	12.79 ^a (20.94)	11.96 ^a (20.23)	12.04 ^a (20.26)
T7	Control	20.19 (26.68)	20.26 ^c (26.75)	21.01 ^c (27.27)	20.80 ^c (27.13)	22.74 ^d (28.48)	20.12 ^c (26.65)	22.61 ^c (28.37)	22.27 ^c (28.14)	23.41 ^d (28.93)
SEm+		0.762	0.769	0.856	0.688	0.766	0.660	0.747	0.862	0.739
CD (5%)		2.348	2.371	2.639	2.120	2.360	2.034	2.302	2.655	2.276

Figure in parentheses are retransformed percent values; BSFB = Brinjal shoot and fruit borer; PRP =Prerelease population; DAR = Days after release

Table 2. Influence of egg parasitoid *Trichogramma chilonis* on the BSFB infestation as fruit borer during *kharif* 2016-17

Treatments	Dose release@ /ha	Mean (%) fruits infestation on days of release (number basis)								
		5 th Release			6 th Release		7 th Release		8 th Release	
		PRP	5DAR	7 DAR	5 DAR	7 DAR	5 DAR	7 DAR	5 DAR	7 DAR
T1	6 Releases @ 50,000/ha	18.19 (25.22)	17.99 ^b (25.08)	18.09 ^b (25.17)	17.66 ^b (24.85)	17.83 ^c (24.97)	-	-	-	-
T2	8 Releases @ 50,000/ha	18.01 (25.11)	17.69 ^b (24.86)	17.76 ^b (24.91)	16.81 ^b (24.20)	16.92 ^b (24.29)	16.49 ^c (23.96)	16.68 ^c (24.10)	16.10 ^c (23.65)	16.48 ^c (23.94)
T3	6 Releases @ 100,000/ha	16.99 (24.33)	15.79 ^b (23.37)	15.91 ^b (23.50)	15.38 ^b (23.08)	15.57 ^b (23.22)	-	-	-	-
T4	8 Releases @ 100,000/ha	16.86 (24.23)	14.81 ^b (22.62)	15.06 ^a (22.83)	14.12 ^a (22.07)	14.40 ^b (22.30)	13.88 ^b (21.81)	14.03 ^b (21.99)	13.11 ^b (21.22)	13.41 ^b (21.46)
T5	6 Releases @ 150,000/ha	12.95 (21.08)	11.92 ^a (20.20)	12.41 ^a (20.56)	11.67 ^a (19.93)	11.79 ^a (20.05)	-	-	-	-
T6	8 Releases @ 150,000/ha	12.68 (20.85)	11.14 ^a (19.50)	11.91 ^a (20.12)	11.09 ^a (19.44)	11.28 ^a (19.59)	10.21 ^a (18.63)	10.95 ^a (19.19)	9.80 ^a (18.18)	10.01 ^a (18.36)
T7	Control	21.19 (27.40)	21.95 ^c (27.94)	21.64 ^c (27.71)	21.47 ^c (27.59)	21.87 ^d (27.88)	21.95 ^d (27.93)	21.07 ^d (27.32)	22.24 ^d (28.13)	20.84 ^d (27.15)
SEm+		0.792	0.817	0.959	0.803	0.692	0.735	0.839	0.662	0.671
CD (5%)		2.440	2.517	2.954	2.476	2.134	2.265	2.585	2.041	2.069

Figure in parentheses are retransformed percent values; BSFB = Brinjal shoot and fruit borer; PRP = Pre release population; DAR = Days after release

Table 3. Influence of egg parasitoid *Trichogramma chilonis* on the BSFB infestation as fruit borer during *kharif* 2016-17

Treatments	Dose release@ /ha	Mean (%) fruit infestation on days of release (weight basis)									Parasitization (%)
		5 th Release			6 th Release		7 th Release		8 th Release		
		PRP	5DAR	7 DAR	5 DAR	7 DAR	5 DAR	7 DAR	5 DAR	7 DAR	
T1	6 Release @ 50000/ha	18.11 (25.18)	17.83 ^b (24.97)	18.05 ^c (25.13)	17.55 ^b (24.75)	17.78 ^c (24.94)	-	-	-	-	26.66
T2	8 Release @ 50000/ha	17.58 (24.79)	17.58 ^b (24.79)	17.73 ^b (24.90)	16.78 ^b (24.15)	16.88 ^b (24.24)	16.41 ^c (23.88)	16.56 ^c (23.99)	16.02 ^c (23.58)	16.43 ^c (23.88)	30.30
T3	6 Release @ 100000/ha	16.95 (24.30)	15.72 ^b (23.36)	15.71 ^b (23.35)	15.36 ^b (23.07)	15.53 ^b (23.21)	-	-	-	-	31.49
T4	8 Release @ 100000/ha	16.56 (24.00)	15.63 ^b (23.27)	15.03 ^b (22.80)	14.01 ^b (21.98)	14.36 ^b (22.26)	13.79 ^b (21.80)	13.99 ^b (21.93)	13.08 ^b (21.19)	13.38 ^b (21.45)	33.33
T ₅	6 Release @ 150000/ha	12.75 (20.92)	12.26 ^a (20.49)	12.38 ^a (20.59)	11.59 ^a (19.90)	11.65 ^a (19.90)	-	-	-	-	47.05
T ₆	8 Release @ 150000/ha	12.43 (20.63)	11.88 ^a (20.13)	11.87 ^a (20.12)	11.01 ^a (19.34)	11.19 ^a (19.52)	10.15 ^a (18.57)	10.92 ^a (19.28)	9.76 ^a (18.17)	9.90 ^a (18.32)	47.61
T ₇	Control	20.56 (26.96)	20.29 ^c (26.77)	20.76 ^d (27.10)	20.02 ^c (26.57)	20.77 ^d (27.11)	19.59 (26.27)	20.13 (26.65)	19.70 (26.34)	20.77 (27.11)	-
SEm±		0.725	0.716	0.721	0.741	0.804	0.488	0.702	0.434	0.560	-
CD (5%)		2.233	2.216	2.221	2.283	2.248	1.510	2.160	1.287	1.736	-

Figure in parentheses are retransformed percent values; BSFB = Brinjal shoot and fruit borer; PRP = Pre release population; DAR = Days after release

Economics and cost benefit ratio

The egg parasitoid releases were aimed to get an economic return by increasing the production and reducing the damage caused by the insect pest. Taking this into consideration the economics of each release was worked out. The data presented during *Kharif 2016-17* revealed that

all the treatments were found to be profitable over control. The maximum net profit of Rs. 328,950 and the highest cost benefit ratio of 1:10.31 were recorded for *T. chilonis* release eight times @ 150,000/ha. The minimum net profit of Rs. 49,750 and lowest cost benefit ratio of 1:1.024 were recorded for *T. chilonis* release six times @ 50000/ha (Table 4).

Table 4. Economic and cost benefit ratio of different treatments against *Leucinodes orbonalis* in brinjal during *kharif 2016-17*

Treatments	No. of sprays	Average yield (q/ha)	Gross return (Rs.)	Increased yield over control (q/ha)	Value of increased yield over control (Rs./ha)	Management Cost (labour + Trichocard) (Rs./ha)	Net profit (Rs./ha)	B:C Ratio
T1: 6 release @ 50,000/ha	6	213	319500	35	52500	1250	51250	1:1.024
T2: 8 release @ 50,000/ha	8	248	372000	70	105000	2550	102450	1:1.025
T3: 6 release @ 100,000/ha	6	306	459000	128	192000	5050	186950	1:1.027
T4: 8 release @ 100,000/ha	8	334	501000	156	234000	6350	227650	1:1.028
T5: 6 release @ 150,000/ha	6	373	559500	195	292500	8450	284050	1:1.030
T6: 8 release @ 150,000/ha	8	404	606000	226	339000	10050	328950	1:1.031
T7:Control	0	178	267000	-	-	-	-	-

(1)Present price of Trichocard: one trichocard = Rs. 40 (1 trichocard = 20000 eggs of *T. chilonis*); (2)Labour charge: 4 Labour @ Rs. 250; (3)Sale price of brinjal Rs. = 15/- kg

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