

Inundative release of egg parasitoid *Trichogramma bactrae* in cotton

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ABSTRACT

A field experiment was conducted at cotton research station, Junagadh Agricultural University, Junagadh during *kharif* 2016, 2017 and 2018 to evaluate egg parasitoid *Trichogramma bactrae* through inundative release in cotton crop for management of pink bollworm. Result showed that minimum percent rosette flower, percent green boll damage and percent open boll damage were noticed insecticide treated plot followed by release of *Trichogramma bactrae*. Significantly highest yield pooled data observed that chemical treated plot followed by release of *Trichogramma bactrae*. However, the highest benefit cost ratio was revealed in release of *Trichogramma bactrae* plot followed by chemical treated plot.

Key words: Inundative release, egg parasitoid, *Trichogramma bactrae*, cotton

INTRODUCTION

Cotton, *Gossypium spp.* is one of the commercially important fibre crop in the world for fibre, fuel and edible oil, is playing an important role in Indian economy. In Gujarat state, cotton was grown in 2.27 million ha and production of 7.27 million bale during 2020-21 [1]. In the recent past, Pink bollworm (*Pectinophora gossypiella* Saunders) has become a major threat to *Bt* Cotton in the last 2 years and is causing considerable loss to Cotton, in terms of Evaluation of egg parasitoid *Trichogramma bactrae* through inundative release of the crop has now become a major problem in *Bt* Cotton hybrids appearing from the flowering stage of the crop and inflicting damage if unattended. World over, Pink bollworm, *Pectinophora gossypiella* (Saunders) has become economically the most destructive pest of Cotton and has known to cause 2.8 to 61.9 per cent loss in seed cotton yield, 2.1 to 47.10 per cent loss in oil content and 10.70 to 59.20 per cent loss in normal opening of bolls [2]. Estimated yield losses in the U.S.A. due to pink bollworm range from 9% when chemically controlled to 61% when uncontrolled [3], although 100% crop loss can occur with heavy infestations. The control of this pest depends largely on the application of pesticides, which has precipitated the development of resistance. As a result, in order to achieve effective control, more chemical applications per season are needed [4]. Furthermore, to control this pest alternative control strategies like release of egg parasitoids at ETLs in combination with insecticidal sprays are being studied. The egg parasitoids, *Trichogrammatoidea spp.* have been used in IPM of cotton for the control of *P. gossypiella* and proved as good biological agents in the laboratory [5]. Several studies revealed the role of *Trichogramma spp.* in controlling different insect pests infesting the cotton crop in different parts of the world [6, 7]. The present study was undertaken to evaluation of egg parasitoid *Trichogramma bactrae* through inundative release.

Mass rearing and release of natural enemies represents an important tactic of IPM strategy and it has successfully been used to combat many pest including cotton bollworms [8]. Among certain natural enemies, Egg parasitoids, *T. chilonis*, *T. japonicumare* and *Trichogramma bactrae* common biological control agents successfully used in biological control programs in corn, rice, sugarcane and cotton in India. Parasitoid *Trichogramma* is cosmopolitan in distribution and capable of parasitizing on pink bollworm eggs [9]. The other advantages associated with *Trichogramma* are low cost in comparison with chemical pesticides, ease of application, availability, ecofriendly and most importantly pest control before the damage. Besides pink bollworm, there is a complex of lepidopteron pests associated with cotton ecosystem which can also be controlled by *Trichogramma spp.* keeping these in view, management of cotton pink bollworm with *Trichogramma spp. viz., Trichogramma bactrae*.

MATERIALS AND METHODS

Evaluation of different treatment for management of pink bollworm in *Bt* cotton was studied in *Bt* cotton hybrid “NCS 860 BG-II” during *Kharif* seasons of 2016, 2017 and 2018 at Cotton Research Station, Junagadh Agricultural University, Junagadh, Gujarat (India). The experiment was carried out randomized block design with eight times replicated with three treatments, viz., biological control treatment, insecticide control treatment and an untreated control treatment. The crop was grown under rainfed conditions in heavy black soil at a spacing of 120 x 45 cm with a plot size 8.55 x 20.4 m following all recommended agronomic practices except plant protection measures. The treatments viz., biological control *i.e.* *Trichogramma bactrae* released @ 150000/ha at two specific crop stage viz., flowering stage (40-50 DAS) and boll maturation stage (60-75 DAS). Two time release at flowering stage at weekly interval and three time releases at boll maturation stage at weekly interval; an insecticidal treatment *i.e.* three alternate sprays of profenophos 50 EC (2ml/l of water), thiodicarb 75 WP (1g/l of water) and cypermethrin 10 EC (1ml/l of water) at 40, 60 and 90 days, respectively after germination and a control plot was also kept which accounts for the natural incidence of the pest. In untreated control plot, no insecticidal sprays were taken up during the entire crop season. For field release of *Trichogramma bactrae*, one day old parasitized egg trico-cards (30x18cm) were pinned on to a leaf at about 50 cm height above ground.

Method for recording observation

Rosette Flowers

In each treatment, after initiation of flowering, a day before flower opening observations on rosette flowers due to pink bollworm infestation was made on 5 randomly selected plants. Total number of flowers and rosette was counted and percent rosette flowering was worked out.

$$\text{Per cent rosette flowers} = \frac{\text{Number of rosette flowers}}{\text{Total number of flowers}} \times 100$$

Per cent green boll damage

In each treatment, the number of 20 green bolls randomly selected from net plot area, the number of bolls damaged by pink bollworm was counted and expressed in terms of per cent green boll damage using the formula

$$\text{Per cent green boll damage} = \frac{\text{Number of damaged green bolls}}{\text{Total number of green bolls observed}} \times 100$$

Per cent opened boll damage

At the time of each cotton picking g, five randomly selected plants were observed in all opened bolls from each treatment. Based on this, per cent opened boll damage was worked out by

$$\text{Per cent open boll damage} = \frac{\text{Damage opened bolls}}{\text{Total opened bolls}} \times 100$$

Per cent locule damage

At the time of each cotton picking, five randomly selected plants were observed in all opened bolls than from each treatment. Total number of locules and damaged locules was counted and expressed in terms of per cent locule damage,

$$\text{Percent locule damage (\%)} = \frac{\text{Damaged locules}}{\text{Total number of locules}} \times 100$$

Seed cotton yield

From each treatment, weight of seed cotton (kg/ha) during each picking was recorded.

The observations on percentage of rosette flowers, per cent green boll damage, locule damage, per cent open boll damage and seed cotton yield in each treatment was recorded. The data was subjected to suitable transformations before analysis and later analyzed.

Observations recorded

1. Percentage of rosette flowers
2. Per cent green boll damage

3. Per cent open boll damage
4. Percent locule damage
5. Seed cotton yield (kg/ha)

RESULTS AND DISCUSSION

A study was conducted to Evaluation of egg parasitoid *Trichogramma bactrae* through inundative release during kharif 2016, 2017 and 2018. It is seen from the data in Table 1 that all treatments were significantly superior over untreated control. The pooled data showed that the significantly lowest per cent rosette flower (12.64%) was observed in chemical treated plot followed by *Trichogramma bactrae* (16.96%), while the highest per cent rosette flower was noticed in control plot (22.06%). Similarly, the significantly green boll damage (14.04%) was observed in chemical treated plot followed by *Trichogramma bactrae* (18.24%), while the highest green boll damage was noticed in control plot (22.51%). At the time of harvesting, The significantly lowest open boll damage and locule damage (6.26% & 2.91%) was noticed in chemical treated plot

Table 1: Evaluation of egg parasitoid *Trichogramma bactrae* through inundative release.

Sr. No.	Treatments	Rosette flower percentage				Green boll damage percentage				Open boll damage percentage							
		2016-17	2017-18	2018-19	Pooled	2016-17	2017-18	2018-19	Pooled	Boll basis				Locule basis			
1	<i>Trichogramma bactrae</i>	26.24 (19.55)	24.27 (16.90)	22.44 (14.58)	24.32 (16.96)	28.73 (23.10)	22.64 (14.82)	24.47 (17.16)	25.28 (18.24)	17.48 (9.02)	16.75 (8.31)	14.57 (6.33)	16.27 (7.85)	12.26 (4.51)	13.46 (5.42)	9.85 (2.93)	11.86 (4.22)
2	Profenofos 50 EC + Thiodicarb 75 WP + Cypermethrin 10 EC	22.06 (14.10)	20.65 (12.43)	19.78 (11.45)	20.83 (12.64)	24.56 (17.27)	20.03 (11.73)	21.43 (13.35)	22.01 (14.04)	16.21 (7.79)	14.62 (6.37)	12.63 (4.78)	14.49 (6.26)	11.36 (3.88)	10.06 (3.05)	8.03 (1.95)	9.82 (2.91)
3	Control	30.17 (25.25)	28.12 (22.22)	25.75 (18.87)	28.01 (22.06)	31.91 (27.93)	26.71 (20.21)	26.35 (19.70)	28.32 (22.51)	19.40 (11.03)	20.18 (11.90)	18.61 (10.18)	19.40 (11.03)	13.99 (5.84)	14.19 (6.01)	11.82 (4.20)	13.33 (5.32)
	S.E.m.±	0.85	1.00	0.83	0.52	0.77	0.96	0.74	0.48	0.53	0.83	0.53	0.37	0.36	0.47	0.41	0.24
	C.D. at 5 %	2.63	3.08	2.56	1.49	2.38	2.95	2.29	1.37	1.64	2.56	1.62	1.07	1.12	1.44	1.26	0.69
	C.V. %	8.65	10.85	9.71	9.47	7.18	10.94	8.18	8.71	7.98	12.77	9.13	10.22	7.68	9.84	10.91	9.42
	Y																
	S.E.m.±	--	--	--	0.52	--	--	--	0.48	--	--	--	0.37	--	--	--	0.24
	C.D. at 5 %	--	--	--	1.49	--	--	--	1.37	--	--	--	1.07	--	--	--	0.69
	YXT																
	S.E.m.±	--	--	--	0.90	--	--	--	0.83	--	--	--	0.65	--	--	--	0.42
	C.D. at 5 %	--	--	--	NS	--	--	--	NS	--	--	--	NS	--	--	--	NS

Figure in parenthesis are original values; those outside are arcsine transformed values

followed by *Trichogramma bactrae* (7.85% & 4.22%), while the highest open boll damage and locule damage was noticed in control plot(11.03%& 5.32%).

Seed cotton yield (kg/ha)

The pooled data of the years (2016, 2017 and 2018) showed that the yield was observed significantly different in all the treatments, among them the chemical treatment noted significantly higher seed cotton yield (2687 kg/ha) followed by *Trichogramma bactrae* treated plot (2516 kg/ha) and control treatment recorded lowest seed cotton yield (2082 kg/ha) (Table 2).

Table 2: Evaluation of egg parasitoid *Trichogramma bactrae* through inundative release on yield of seed cotton.

Sr. No.	Treatments	Seed cotton yield			
		2016-17	2017-18	2018-19	Pooled
1	<i>Trichogramma bactrae</i>	2315	2525	2708	2516
2	Profenofos 50 EC + Thiodicarb 75 WP + Cypermethrin 10 EC	2401	2726	2934	2687
3	Control	1995	2052	2201	2082
	S.E.m.±	71.25	79.77	88.52	46.28
	C.D. at 5 %	219.56	245.81	272.78	132.85
	C.V. %	8.43	8.67	8.96	8.73
	Y				
	S.E.m.±	--	--	--	46.28
	C.D. at 5 %	--	--	--	132.85
	YXT				
	S.E.m.±	--	--	--	80.16
	C.D. at 5 %	--	--	--	NS

Economics

The result on economics of different treatments against pink bollworm cotton showed that highest net realization of Rs. 27,780/- was noticed in chemical treatment followed by *Trichogramma bactrae* treated plot

(Rs. 21400/-). However, the highest ICBR was found in *Trichogramma bactrae* treated plot i.e. 1:72.33, while chemical treatment noted ICBR of 1:12.25.

Table 3: Economics of egg parasitoid *Trichogramma bactrae* through inundative release.

Sr. No.	Treatment	Yield (Kg/ha)	Yield increased over control (Kg/ha)	Additional income (Rs.)	Cost of treatment with labour charge Rs/ha	Net Realization Rs/ha	ICBR
1	<i>Trichogramma bactrae</i>	2516	434	21700	300	21400	1 : 72.33
2	Profenofos 50 EC + Thiodicarb 75 WP + Cypermethrin 10 EC	2687	605	30250	2470	27780	1 : 12.25
3	Control	2082	0	0	0	-	-

1. Quantity of water: 500 lit. /ha

2. Cost of Input: 1. Cost of respective treatment (Rs. /kg or lit.):

1) *Trichogramma bactrae* Rs. 300/-

2) Profenofos 50 EC + Thiodicarb 75 WP + Cypermethrin 10 EC 1838 + 632 = Rs. 2470/-

2. Labour charges (Rs. /ha) = Rs. 632/-

3. Price of cotton Rs. 50 per kg

CONCLUSION

Looking to the efficacy and yield, the chemical treatment found to be the most effective, while the treatment of *Trichogramma bactrae* was economic. So, it can be concluded that for organic farming cotton production, application of *Trichogramma bactrae* @ 1.5 lakh parasitoid eggs per hectare viz; two release at flowering stage (40-50 days) at weekly interval and three releases at boll maturation stage (60-75 days) at weekly interval is effective and economic for management of pink boll worm.

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