Journal of Biological Control, 34(3): 223-226, 2020, DOI: 10.18311/jbc/2020/25442

Research Note

Field potential of *Trichogrammatoidea bactrae* Nagaraja as an egg parasitiod against pink bollworm, *Pectinophora gossypiella* (Saunders) in cotton

M. S. MAHALAKSHMI* and N.V.V.S.D. PRASAD
Regional Agricultural Research Station, Lam, Guntur–522034, Andhra Pradesh, India
**Corresponding author E-mail: msmlaxmi@gmail.com*

ABSTRACT: An experiment was conducted at Regional Agricultural Research Station, Lam, Guntur to evaluate the field efficacy of an egg parasitoid, *Trichogrammatoidea bactrae* Nagaraja through inundative releases against pink bollworm, *Pectinophora gossypiella* (Saunders) in cotton for two successive seasons, during *kharif* 2016–17 and 2017–18. The mean larval incidence of pink bollworm was significantly lower in *T. bactrae* released plots with significant reduction in green boll damage and locule damage than untreated control, but significantly higher as compared to insecticide treated plots. Results suggest that the inundative release of *T. bactrae* achieved sizeable control of pink bollworm, hence it can be integrated with other control measures for sustainable management of pink bollworm.

KEY WORDS: Cotton, egg parasitoid, pink bollworm, *Tr. bactrae*

(Article chronicle: Received: 06-06-2020; Revised: 11-09-2020; Accepted: 13-09-2020)

Cotton (*Gossipium hirsutum* L.) is the most important commercial crop grown in India. Cotton is cultivated in 105 lakh hectares in India with a productivity of 568 kg lint/ha and ranks first in production with 351 lakh bales (AICCIP, 2016-17). Though, India ranks first in the world with regard to acreage, the productivity is low as compared to other cotton growing countries. Among various factors responsible for the low yield, the losses caused by insect pests are of major importance. The bollworms alone are known to cause 50 per cent yield loss in cotton (Geeta, 2000). Among cotton bollworms, the pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) is a pest of great economic importance in many cotton-growing countries causing yield loss both in terms of quantity as well as quality. After the introduction of Bt cotton during 2002 in India, the incidence of pink bollworm had declined greatly and it was negligible during the last decade. But, during recent past, it has emerged as a threat to cotton cultivation in India even in stacked Bt (BG II) cotton hybrids (Naik *et al.,* 2018). The control of this pest depends largely on the application of pesticides, because of concealed nature of larvae inside the developing bolls. Hence, use of insecticides including synthetic pyrethriods is more during the season to achieve effective control (Natwick, 1987, Prasad *et al.,* 2007). Alternative control strategies, such as use of synthetic pheromone for mass trapping or mating disruption, use of cultural practices such as early sowing and early termination of crop and use of bio control agents are being studied for their potential role in an integrated pest management program for pink bollworm. *Trichogrammatoidea* spp. are egg parasitoids of lepidopteran insects. Morphologically, *Trichogrammatoidea* Girault resembles the more commonly known genus, *Trichogramma* Westwood, which contains numerous species of economic importance (Hutchison *et al*., 1990). The egg parasitoid, *Trichogrammatoidea bactrae* Nagaraja (Hymenoptera: Trichogrammatidae) have been used in IPM of cotton for the control of *P. gossypiella* and proved as an effective biological agent (Malik, 2001). Thus, an experiment was conducted to evaluate the potential of an egg parasitoid, *Tr. bactrae* against pink bollworm in cotton.

A field experiment was conducted at Regional Agricultural Research Station, Lam, Guntur (16° 18'N; 80° 26'E) for two successive seasons during kharif 2016–17 and 2017–18. The variety, Suraj was sown in July second fortnight at 105×60 cm spacing. The trial was laid in a randomised block design with three treatments and were replicated for seven times. Pigeonpea was sown as a barrier crop around each experimental plot in an area of 40 sqm^2 to reduce the possibility of parasitoid dispersal from on experimental plot

to another and thus interference between the treatments was evaded. The *Tr. bactrae* (National Accession No. NBAII-MP-TRI-02) egg cards were obtained from ICAR-National Bureau of Agricultural Insect Resources (NBAIR), live insect repository, Bengaluru. Tricho-cards were cut into pieces and stapled to the underside of the leaves in such a way that the eggs faced towards the open area at the early morning hours to avoid direct exposure to sun. Inundative release of *Tr. bactrae* @ 60,000/ha was done in two spells i.e., twice at flowering stage (45 DAS onwards) at weekly interval and thrice from boll formation stage (60-75 DAS) at weekly interval. Foliar spray of insecticides such as profenophos 50 EC @ 2.0 ml/ lt at 40 DAS, thiodicarb 75 WP @ 1.0 gm/lt at 60 DAS and cypermethrin 25 EC @ 1.0 ml/lt at 90 DAS were taken at different growth stage as an insecticidal treatment. An untreated control plot was maintained without intervention of any control measure. The data on larval incidence and locule damage was recorded through destructive sampling of green bolls at monthly interval from 90 days onwards and the infestation percentage was estimated by dissecting the green bolls at the same day of collection. The data on seed cotton yield was recorded at the time of harvesting. The experimental plots were protected against sucking pests with selective and relatively safer insecticides up to 40 days after sowing and at later stages to maintain crop healthiness and to avoid yield losses due to sucking pests. The data thus obtained was subjected to statistical analysis, ANOVA after using appropriate transformations. The boll and the locule damage were calculated using the following formulae.

Boll damage % = (Number of infested bolls/ Total number. of collected bolls) ×100

Locule damage % = (Number of infested locules/ Total number. of locules) ×100

The larval incidence was low and below economic threshold level at 90 DAS in all the treatments which increased gradually at 120 and 150 DAS and slightly declined at 180 DAS and the mean data was presented hereunder. There was significant difference in larval incidence, percentage of green boll damage and percentage of locule damage in various treatment (Table 1). The mean larval incidence in chemical insecticide treated plots was 4.08/ 20 green bolls and was significantly lower than field released with *Tr. bactrae* (5.69 larvae/ 20 green bolls). Both the treatments were found significantly superior over the untreated control (7.95 larvae/20 green bolls). The green boll damage was also significantly higher in untreated control (51.88%) as compared to the *Tr. bactrae* released plots (40.10%) and insecticide treated plots (28.72%) (Table.1). The per cent locule damage was significantly lower in the insecticidal treated plots (20.75%) when compare to *Tr. bactrae* released plots (26.51%). The higher percentage of locule damage was recorded in untreated control (38.97 %) when compared to insecticide treatments and *Tr. bactrae* released plots (Table 1).

Table 1. Evaluation of egg parasitoid, *Tr. bactrae* through inundative releases for control of pink bollworm

Trt. No.	Treatments	No. of PBW larva/20 bolls*	Green boll damage (%) **	Locule damage in green bolls (%) **	Seed cotton yield (Q/ha)
T1	*Tr. bactrae* @ 60,000/ha (2 times at Flowering (40-45DAS) + 3 times from boll formation (60-75DAS) stage)	5.69 [b] (2.59)	40.10 [b] (39.31)	26.51 [b] (31.01)	12.37 [b]
T2	Profenophos 50 EC @ 2.0 ml/l – at 40 DAS (1st Spray) Thiodicarb75 WP @ 1.5 gm/l - at 60 DAS (2nd Spray) Cypermethrin 25 EC @1.0 ml/l - at 90 DAS (3rd Spray)	4.08 [a] (2.25)	28.72 [a] (32.42)	20.75 [a] (27.11)	14.14 [a]
T3	Untreated control	7.95 [c] (2.99)	51.88 [c] (46.10)	38.97 [c] (38.65)	10.14 [c]
F Test		**Sig**	**Sig**	**Sig**	**Sig**
C.D. (P=0.05)		0.16	6.02	3.71	1.57
SE (d)		0.07	2.53	1.60	0.60
C.V. %		5.60	12.90	9.55	11.05

*figures in parenthesis are √X+1 transformed values
**figures in parenthesis are arcsine transformed values
(*Tr. bactrae* - the national Accession No.NBAII-MP-TRI-02)

The seed cotton yield has significantly differed in various treatments (Table 1). The seed cotton yield obtained in insecticide treated plots and *Tr. bactrae* released plot was 14.14 q/ha and 12.37 q/ha, respectively. The seed cotton yield was 10.14 q/ha in untreated control.

The results suggest that the lower larval incidence, green boll damage and less locule damage in tricho cards treatment and insecticidal treatment over untreated control can be attributed to initial suppression of eggs through release of egg parasitoid, *Tr. bactrae* and control of first instar larvae by foliar sprays of insecticides. The inundative release of *Tr*. *bactrae* from the early part of the season itself leads to the control of pink bollworm to some extent in cotton. This level of control might be insufficient to prevent the late season outburst of pink bollworm populations. But it can be integrated with other management strategies for effective management of pink bollworm in cotton. The results are in close proximity with many of the earlier reports (Malik, 2001; Mohamed *et al*., 2016), which revealed that the role of *Trichogramma* spp. in controlling different insect pests infesting the cotton in different parts of the world. Early-season release would permit parasitoids to attack pink bollworm eggs on the cotton plant surface such as flower bracts, young bolls and may reduce the need for disruptive pesticides in the first half of the season. *Trichogrammatoidea bactrae* will readily attack the eggs of other lepidopteran species commonly found in cotton and appear to prefer larger host size when given a choice in the laboratory (Naranjo *et al*. 1992). This has significant role, because pink bollworm eggs are relatively smaller in comparison to the noctuiid moths inhabiting cotton. Additionally, laboratory studies indicate that female parasitoids prefer young eggs (1 -2 d old), thus, even if eggs were present on bolls their age-distribution probably influenced susceptibility to parasitoid attack (Hutchison *et al*. 1990). The efficacy of egg parasitiod or parasitisation depends on many biotic and abiotic factors such as host density, release rate, temperature, wind speed, wind direction. Malik (2001) reported up to 18 per cent parasitisation of pink bollworm eggs by *Tr. bactrae* through release of adults @ 1,44,000/ha in pima cotton. Release of parasitoid, *Tr. bactrae* proved best in reducing pink bollworm infestations in the fallen cotton flower buds and/or squares as well in the green bolls compared to both insecticides and check treatments in Egypt (Mesbah *et al*., 2003). The treatments of BIPM practice registered 3.43 and 2.41 per cent damage to green bolls and locule as against 4.43 and 3.08 per cent in farmer's practices, respectively but, both these treatments recorded significantly low incidence of PBW compared to untreated check (Godhani *et al*., 2010). *Trichogramma* are cheaper in cost compared to chemicals (Almeida, 1996) and combinations of biological agents and chemical control also proved successful for control of pink bollworm (Sarwar, 2017). Recently, Mohamed *et al*. (2016) reported that four releases at early flowering stage (<50%) caused 91.56 % reduction in the infestation of pink bollworm in cotton as compared to single release of parasitoid and resulted in highest boll weight.

CONCLUSION

Though, the parasitism by *Tr. bactrae* was not very high enough for control of pink bollworm as a single strategy, it can be integrated with other measures. Frequent releases of the parasitiod are necessary to avoid economic damage by the pink bollworm. Parasitiod density and release pattern must be studied further to achieve high success rate. Farmers must integrate biological control with cultural and pheromone-based control measures to combat the menace from pink bollworm in cotton.

ACKNOWLEDGEMENTS

Authors are highly thankful to AICCIP for financial support, ANGRAU, Guntur for providing land and man power and NBAIR, Bangalore for timely supply of Tricho-cards for conducting the experiment.

REFERENCES

AICCIP (All India Coordinated Cotton Improvement Project), Annual Report 2017–2018.

Almeida R P de. 1996. Biotechnology of mass production of Trichogramma spp. via the alternative host *Sitotroga cerealella*. Campina Grande EMBRAPA-CNPA Technical circular **(19)**: 36.

Geeta B. 2000. *Bt* cotton in India. Anatomy of a controversy. *Cur. Sci.* **79**(8):1067-1075.

Godhani P H, Patel R M, Patel B H and Korat D M. 2010 Evaluation of bio-intensive pest management module for the management of cotton pink bollworm, *Pectinophora gossypiella* (Saund.). *KN J. Agril. Sci.* **23**(2): (364–365).

Hutchison W D, Moratorio M. and Martin J M 1990. Morphology and biology of *Trichogrammatoidea bactrae* (Hymenoptera: Trichogrammatidae), imported from Australia as a parasitiod of Pink bollworm (Lepidoptera: Gelichidae) eggs. *Ann. Entomol. Soc. America*. **83**: 46–54. https://doi.org/10.1093/aesa/83.1.46

Malik F M. 2000. Life table studies of *Trichogrammatoidea bactrae* (Hymenoptera: Trichogrammatidae) an effective biological agent of Pink bollworm (*Pectinophora gossypiella*, Lepidoptera: Gelechiidae) of cotton (Gossypium spp.). *Pak. J. Boilogic. Sci.* **3**(12): 2106–2108. https://doi.org/10.3923/pjbs.2000.2106.2108

Malik M F 2001 Biological control of pink bollworm (*Pectinophora gossypiella*, Lepidoptera: Gelichidae) by *Trichogrammatidea bactrae* (Hymenoptera: Trichogrammatidae) in cotton (*Gossypium barbadense*). *Online J biol. Sci*. **1**(6): 488–489. https://doi.org/10.3923/jbs.2001.488.489

Mesbah, A H, Shoeb, M A., El-Heneidy, A.H. 2003. Preliminary approach towards the use of the egg parasitoid, *Trichogrammatoidea bactrae* Nagaraja against cotton bollworms in Egyptian cotton fields. *Egypt J Agril. Res*. **81**(3): 981–995.

Naik C B V, Kumbhare S, Kranthi S, Usha S and Kranthi K R. 2018. Field evolved resistance of pink bollworm, *Pectinophora gossypiella* (Saunders) (*Lepidoptera:Gelechiidae*) to transgenic Bt-cotton expressing Cry1Ac and Cry2Ab in India. *Pest Manag Sci*. **74**(11): 2544–2554. https://doi.org/10.1002/ps.5038

Natwick, E.T., 1987 Cotton insects and production, Colorado River Cotton Growers Association, El Centro, CA: 3–4.

Mohamed H O, El-Heneidy A H, Ali A G and Awad A A. 2016. Non-chemical control of the pink and spiny boll worms in cotton fields at Assuit Governorate, Upper Egypt II-utilization of the egg parasitoid, *Trichogrammatoidea bactrae* Nagaraja. *Egypt J. Biol Pest Control.* **26**(4): 807–813.

Naranjo S E, Gordh G. and Moratorio M. 1992. Biology and behavior of *Trichogrammatoidea bactrae*, an imported egg parasitoid of pink bollworm. *In* D.J. Herberand D.A. Richter, eds., Proceedings, Beltwide Cotton Conferences, Memphis, Tennessee: National Cotton Council. pp. 920–922.

Prasad, N V V S D., Mahalakshmi M S. and Rao N.H.P. 2007. Efficacy of insecticides against pink bollworm, *Pectinophora gossypiella* (Saunders) on cotton. *Indian J. Environment & Ecoplanning*, **14**(3): 459–462.

Sarwar M. 2017. Pink bollworm *Pectinophora gossypiella* (Saunders) [Lepidoptera: Gelechiidae] and practices of its integrated management in cotton. *Int. J. Pl. Sci. Ecol*. **3**(1): 1–6.