VOL. XII, ISSUE XXXXI, JANUARY 2022 MULTILOGIC IN SCIENCE ISSN 2277-7601
An International Refereed, Peer Reviewed & Indexed Quarterly Journal for Applied science

PARASITIC EFFICIENCY OF TRICHOGRAMMATOIDEA BACTRAE NAGARAJA ON EGGS OF DIFFERENT BOLLWORMS

MS Kuyate, VK Bhamare and DG Ingale
Department of Agricultural Entomology, College of Agriculture,
Latur (MS) India-413 512
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (MS) India-431 402

(MS Received: 05.10.2021; MS Revised: 06.11.2021; MS Accepted: 08.11.2021)

MS 2797 **(RESEARCH PAPER IN AGRICULTURAL ENTOMOLOGY)**

Abstract

The present investigation on "Parasitic efficiency of Trichogrammatoidea bactrae Nagaraja on eggs of different bollworms" was carried out at Bio-control Laboratory, Department of Agricultural Entomology, College of Agriculture, Latur (VNMKV, Parbhani), Maharashtra-India during 2018-19. The parasitic efficiency recorded on four different host eggs viz., Corcyra cephalonica Stainton, Helicoverpa armigera Hubner, Pectinophora gossypiella Saunders and Spodoptera frugiperda J.E. Smith under laboratory conditions at ambient room temperature of 28 ± 3°C. The parasitic efficiency of Tr. bactrae on four different host eggs ranged from 56.50 to 78.50 per cent under the laboratory condition at 28 ± 3°C. Among the different host eggs, maximum average parasitism was registered on the eggs of C. cephalonica (78.50 ± 4.95 per cent) followed by P. gossypiella (63.50 ± 9.19 per cent), H. armigera (61.50 ± 9.19 per cent) and minimum parasitisation was observed on the eggs of S. frugiperda (56.50 ± 6.36 per cent). The findings of present study made it clear that parasitisation capacity of Tr. bactrae was significantly higher on the eggs of C. cephalonica compared to remaining host eggs under investigation. Thus, it is proved that parasitic efficiency of parasitoid is influenced by host.

***Key words**: Parasitic efficiency, Trichogrammatoidea bactrae, Bollworms*

Introduction

Trichogrammatids are smallest insects, ranging in size from 0.2 to 1.5 mm, solitary or gregarious idiobiont endoparasitoids of insect eggs. The family Trichogrammatidae is represented by over 800 described species in approximately 90 genera worldwide and is recognized from all vegetated terrestrial habitats (Pinto, 2006).

Trichogrammatoidea bactrae Nagaraja is an egg parasitoid widely distributed in the oriental region of the world, adapted to terrestrial humid habitats and known to attack various insect-pests of cotton, sugarcane, fruits and vegetables (Nagaraja, 1978). *Tr. bactrae* found to attack eggs of many lepidopterous insect-pests such as *Helicoverpa armigera* Hubner (Rao *et al*., 1980), *Earias vittella* Fabricius (Rao *et al*., 1980), *Achaea janata* Linnaeus (Rao *et al*., 1980), *Atherigona soccata* Rondani (Rao *et al*., 1987), *Pectinophora gossypiella* Saunders (Hutchison *et al.* (1990), *Plutella xylostella* Linnaeus (Keinmeesuke *et al*. (1992), *Chilo infuscatellus* Snellen (Singh, 1994), *Epiphyas postvittana* Walker (Stevens, 1995), *Ctenopseustis obliquana* Walker (Stevens, 1995), *Etiella zinckenella* Treitschke (Herlinda *et al*., 1997), *Spodoptera litura* Hubner (Djuwarso *et al*., 1999), *Tuta absoluta* Meyrick (Virgala and Botto, 2010) and *Cnaphalocrocis medinalis* Guenee (Perera *et al*., 2015).

Use of *Trichogrammatoidea* sp. in different pest control programme proves satisfactory as it gives high level of pest suppression in the field (Malik, 2001a; Liu *et al*., 2004; Krishnamoorthy, 2012 and Mohamed *et al*., 2016). However, the success of its release depends upon the factors such as interaction with target host, strain released and different biological characters that determine the efficacy of parasitism (Bourchier and Smith, 1996). Keeping this in view, the biology of *Tr. bactrae* on different host eggs need to be investigated so as to generate information pertaining to most suitable host eggs of bollworm on cotton for effective parasitisation and ultimately the management of the pests.

Materials and Methods

The studies on parasitic efficiency of *Tr. bactrae* on four different host eggs *viz*., *C. cephalonica*, *H. armigera, P. gossypiella* and *S. frugiperda* were carried out in a Completely Randomized Design replicated 5 times. Eggs of different hosts were obtained from laboratory reared culture of the host insects at Bio-Control Laboratory of Department of Agril. Entomology, College of Agriculture, Latur during 2018-19.

The experiment was conducted to study the parasitic efficiency of parasitoid *Tr. bactrae* on different host eggs *viz*., *C. cephalonica, H. armigera, P. gossypiella* and *S. frugiperda* under laboratory conditions. Glass tube (measuring 15 cm in length and 2.5 cm in diameter) was used as experimental unit. One pre-mated female was introduced into the experimental tube which was also provided with 80 per cent honey solution soaked in cotton swab as adult food. For determining parasitism rate, 20 freshly laid, U.V. irradiated eggs of respective host glued on a yellow paper card strip (measuring 4 x 2.5 cm) was introduced into glass tube (parasitoid per host ratio maintained at 1:20). The tube was then closed with cotton plugs. The experiment was conducted until the mortality of parasitoid. The experiment was replicated five times. The per cent parasitism was calculated based on the number of eggs which turned black out of the total number of eggs exposed.

Statistical analysis

The data in respect of biological parameters of *Tr. bactrae* was statistically analyzed by standard 'analysis of variance'. The null hypothesis was tested by 'F' test of significance at 5 per cent level (Gomez and Gomez, 1984).

Results and Discussion

The data pertaining to parasitic efficiency of *Tr. bactrae* on four different host eggs are presented in Table 1 and illustrated through Fig. 1. The data revealed that the extent of average parasitism of *Tr. bactrae* on different host eggs ranged from 56.50 to 78.50 per cent under the laboratory condition at 28 ± 3°C. Among the different host eggs, the maximum average parasitism was registered on the eggs of *C. cephalonica* (78.50 ± 4.95 per cent) followed by *P. gossypiella* (63.50 ± 9.19 per cent), *H. armigera* (61.50 ± 9.19 per cent) and the minimum parasitisation observed on the eggs of *S. frugiperda* (56.50 ± 6.36 per cent).

The findings of present study made it clear that parasitisation capacity of *Tr. bactrae* was significantly higher on the eggs of *C. cephalonica* compared to remaining host eggs under investigation. Thus, it is proved that parasitic efficiency of parasitoid is influenced by host.

Table 1: Parasitic efficiency of *Tr. bactrae* on different host eggs

Sr. No.	Host eggs	No. of host eggs on strip	No. of eggs parasitized			Mean per cent Parasitism (%)
			4th day	5th day	Mean	
1.	*C. cephalonica*	100	75	82	78.5	78.50±4.95

2.	*H. armigera*	100	55	68	61.5	61.50±9.19
3.	*P. gossypiella*	100	57	70	63.5	63.50±9.19
4.	*S. frugiperda*	100	52	61	56.5	56.50±6.36

The results of present investigation are in accordance with the findings of Hemachandra and Perera (2016) who revealed that the level of parasitism of *Cnaphalocrocis medinalis* (Guenee) eggs due to *Tr. bactrae* significantly varied between 0 to 53.76 (mean 8.2 ± 5.7) per cent among sampling sites. Chaubey *et al*. (2014) exhibited that the parasitic efficiency of *Tr. bactrae* on the eggs of *P. xylostella* at different host parasitoid ratio was in the range of 15.0-31.90 eggs per female and per cent parasitism varied from 31.53 to 100.0 per cent. Yan-qing *et al*. (2011) showed that the highest parasitism of *P. xylostella* eggs cards treated with 2000 mg per cm^2 of heptacosane (53.83 per cent) was observed due to *Tr. bactrae*. Palande and Pokharkar (2005) indicated that the parasitism of *Tr. bactrae* was higher in the eggs of *C. cephalonica* (91.36 per cent) than *P. xylostella* (82.46 per cent).

According to Liu *et al*. (2004) the parasitism due to *Tr. bactrae* on eggs of *P. xylostella* was in the range of 30-75 per cent. Singh *et al*. (2004) revealed that the maximum egg parasitisation of *P. xylostella* (83.0 per cent) was recorded in the ratio 100 (host eggs): 5 (parasitoid females), which was on par with other higher ratios of 100:10 to 100:20. Yurong *et al*. (2004) found that *Tr. bactrae*, *T. confusum*, *T. ostriniae*, *Tr. raoi* and *T. bifingensis* contributed 15-57.6 per cent of *P. xylostella* egg parasitism. The results showed that parasitism could reach 75.8 per cent when other parasitoids were released at the same time. Bhardwaj and Gupta (2002) evidenced that the mean parasitisation due to *Tr. bactrae* was registered to the tune of 6.4 and 4.6 eggs on *C. cephalonica* and *P. xylostella*, respectively. El-Hafez and Nada (2000) indicated that the *Tr. bactrae* parasitism on *P. gossypiella* eggs was varied from 16.67-100 (mean 66.19) per cent at different release distances. However, the per cent parasitised eggs of *P. gossypiella* ranged between 0.028 to 16.84 per cent under field conditions of cotton ecosystem. Wuhrer and Hassan (1993) revealed that the ratio of parasitised *Plutella* to *Sitotroga* eggs due to *Tr. bactrae* was 34.4 to 6.1. The ratio of contacts with *Plutella* and *Sitotroga* eggs was 2.6 to 0.2. Keinmeesuke *et al*. (1992) observed 16.2-45.2 per cent parasitised eggs of diamondback moth due to *Tr. bactrae*. Naranjo *et al*. (1992) evidenced that mean parasitism of *P. gossypiella* egg due to *Tr. bactrae* varied between 20 to more 90 per cent during the cotton season. Lim (1986) reported that the mean total number of *C. cephalonica* eggs parasitised by fed mated and virgin parasitoids of *Tr. bactrae fumata* was 49.0 and 48.7, respectively. According to Rao *et al*. (1980) egg parasitisation of *Achaea janata* due to *Tr. bactrae* was in the range of 9.1 to 14.7 per cent. Manjunath (1972) revealed that *Tr. armigera* parasitised 15.5, 20.5, 22.0 and 16.5 per cent eggs of *Achaea janata*, *Corcyra cephalonica, Gnorimoschema operculella* and *Heliothis armigera*, respectively.

Conclusion

In conclusion it is to state that in the present investigation the parasitic efficiency was significantly higher on the eggs of *C. cephalonica* compared to remaining host eggs. Thus, it is proved that parasitic efficiency of parasitoid is influenced by host. Although these results cannot be used to measure parasitoid efficiency in the field, they indicate behaviour to be expected in a mass release programme for the control of the pest. Thus, the biological control with *Tr. bactrae* should target the pest species on the basis of laboratory observations on parasitisation rate and viability. Accordingly, the quantum and frequency of the release of *Tr. bactrae* can be understood.

References

1. **Bhardwaj, P. C. and Gupta, P.R. 2002**. Suitability of *Trichogrammatoidea bactrae* Nagaraja as an egg parasitoid of the diamondback moth *Plutella xylostella* (Linnaeus). *J. Biol. Control*, **16** (2): 113-116.
2. **Bourchier, R.S. and Smith, S.M. 1996.** Influence of environmental conditions and parasitoid quality on field performance of *Trichogramma minutum*. *Entomologia Experimentalis et Applicata*, **80** (3): 461-468.
3. **Chaubey, B. K., Srinivasa Murthy, K. and Jalali, S. K. 2014.** Standardisation of host-parasitoid ratio of *Plutella xylostella* (Linnaeus) and *Trichogrammatoidea bactrae* Nagaraja. *J. Biol. Contr.*, **28** (4): 210-213.
4. **Djuwarso, T., Tengkano, W., Koswanudin, D. and Damayanti, D. 1999.** Potensi *Trichogrammatoidea bactrae bactrae*, Parasitoid Telur Penggerek Polong Kedelai. In Proc. Seminar Nasional Perhimpunan Entomologi Indonesia, Tantangan Entomologi Abad XXI, Bogor: 29-45. **El-Hafez, A.A. and Nada, M.A. 2000**. Augmentation of *Trichogrammatoidea bactrae* Nagaraja in the IPM programme for control of pink bollworm, *Pectinophora gossypiella* (Saunders) in Egypt. *Proceedings Beltwide Cotton Conference*, **2**: 1009-1014.
5. **Gomez, K.A. and Gomez, A. 1984.** Statistical procedure for agricultural research (2ed.). John Wiley and Sons, New York: 680.
6. **Hemachandra, K.S. and Perera, M.C.D. 2016**. Assessment of the egg parasitoid guild of rice leaf folder, *Cnaphalocrocis medinalis* (Guenee): a search for biocontrol agents. *J. Natn. Sci. Found. Sri Lanka*, **44** (2): 185-192.
7. **Herlinda, S., Rauf, A., Kartosuwondo, U. and Budihardjo, D. 1997.** Biology and potential of egg parasitoid, *Trichogrammatoidea bactrae* Nagaraja (Hymenoptera: Trichogrammatidae), for the control of soybean podborer. *Bull. Pl. Pests Dis.*, **9** (2): 19-25.
8. **Hutchison, W. D., Moratorio, M. and Martin, J. M. 1990**. Morphology and biology of *Trichogrammatoidea bactrae* (Hymenoptera: Trichogrammatidae), imported from Australia as a parasitoid of pink bollworm (Lepidoptera: Gelechiidae) eggs. *Ann. Entomol. Soc. Am.*, **83** (1): 46-54.
9. **Keinmeesuke, P., Vattanatangum, A., Sarnthoy, O., Sayampol, B., Miyata, T., Saito, T. and Nakasuji, F. 1992**. Life table of diamondback moth and its egg parasite, Trichogrammatoidea bactrae in Thailand. In ''Diamondback Moth and Other Crucifer Pests: Proc. 2nd Int. Workshop'' (N. S. Talekar, Ed.), AVRDC, Shanhua, Taiwan: 309-315.
10. **Krishnamoorthy, A. 2012.** Exploitation of egg parasitoids for control of potential pests in vegetable ecosystems in India. *Comunicata Scientiae*, **3** (1): 1-15.
11. **Lim, G.T. 1986**. Biological studies on *Trichogrammatoidea bactrae fumata* Nagaraja in the laboratory. *J. Appl. Entomol*., **101** (1): 48-54.
12. **Liu, Shu-sheng, Larry Cooper, Richard R. Llewellyn, Marlene Elson-Harris, John Duff, Michael J. Furlong and Myron P. Zalucki. 2004.** Egg parasitoids of the diamond back moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae), from south-east Queensland. *Aust. J. Entomol*., **43**: 201-207.
13. **Malik, M. F. 2001.** Some biological attributes of *Trichogrammatoidea bactrae*, (Hymenoptera: Trichogrammatidae), at high temperatures in pink bollworm (*Pectinophora gossypiella*, Lepidoptera: Gelechiidae) eggs. *J. Biol. Sci*., **1** (6): 485-487.
14. **Manjunath, T.M. 1972.** Biological studies on *Trichogrammatoidea armigera* Nagaraja, a new diamorphic egg

parasite of *Heliothis armigera* (Hubner) in India. *Entomophaga*, 17 (2): 131-147

15. **Mohamed, Hend O., A.H. E-Heneidy, Abd-Elalim G. Ali and Azza A. Awad. 2016**. Non-chemical control of the pink and spiny bollworms 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.
16. **Nagaraja, H. 1978.** Studies on *Trichogrammatoidea* (Hymenoptera: Trichogrammatoidea). *Oriental insects*, **12** (4): 489-530.
17. **Naranjo, S.E., Gordh, G. and Moratorio, M. 1992**. Inundative release of *Trichogrammatoidea bactrae* for biological control of pink bollworm in Cotton. In: College of Agriculture Report, University of Arizona, Tucson: 110-116 (http;//hdl.handle.net/10150/208636).
18. **Palande, P.R. and Pokharkar, D.S. 2005**. Management of *Plutella xylostella* (Linnaeus) (Lepidoptera: Plutellidae) with *Trichogrammatoidea bactrae* Nagaraja and *Bacillus thuringiensis* Berliner on cabbage. *J. Biol. Contr.*, **19** (1): 35-39.
19. **Perera, M.C.D., Hemachandra, K.S and Sirisena, U.G.A.I. 2015.** *Trichogrammatoidea bactrae* (Hymenoptera: Trichogrammatidae): A potential biocontrol agent of rice leaf folder. *Tropical Agril. Res*., **26** (3): 537-546.
20. **Pinto, John. D. 2006.** A review of the New World genera of Trichogrammatidae (Hymenoptera). *J. Hymenoptera Res*., 15: 38-163.
21. **Rao, K. Jai, Thontadarya, T.S. and Rangadhamaiah, K. 1980.** New record of *Trichogrammatoidea bactrae* Nagaraja (Hym.: Trichogrammatidae) as an egg parasitoids of the castor semilooper *Achaea janata* (Lep: Noctuidae). *Curr. Sci*., 49: 800.
22. **Rao, K. Jai, Thontadarya, T.S. and Yelshetty, Suhas. 1987.** *Trichogrammatoidea bactrae* Nagaraja a new egg parasitoid of sorghum shoot fly, *Atherigona soccata* Rondani. *Curr. Sci*., **56** (6): 283.
23. **Singh, K.I., Jalali , S.K., Rabindra, R.J., Rao, N.S. and Lalitha,Y. 2004**. Role of egg parasitoid, *Trichogrammatoidea bactrae* Nagaraja alone and in combination with dichlorovos in the management of *Plutella xylostella* (Linnaeus) on cabbage. *J. Biol. Control*, **18** (2): 135-139.
24. **Singh, S.P. and Jalali, S.K. 1994.** Trichogrammatids. Technical Bulletin no. 9; Project Directorate of Biological control, Bangalore, **93**: 11-17.
25. **Stevens, P.S. 1995**. Host preferences of *Trichogrammatoidea bactrae* Fumata (Hym:Trichogrammatidae) an egg parasitoid of Leafrollers (Lep.: Tortricidae). *Entomophaga*, **40** (3/4): 379-385.
26. **Virgala, M.B. and Botto, E.N. 2010**. Biological studies on *Trichogrammatoidea bactrae* Nagaraja (Hymenoptera: Trichogrammatidae), egg parasitoid of *Tuta absoluta* Meyrick (Lepidoptera:Gelechidae). *Neotrop Entomol*., **39** (4): 612-617.
27. **Wuhrer, B.G. and Hassan, S.A.1993**. Selection of effective species/strains of *Trichogramma* (Hymenoptera: Trichogrammatidae) to control diamondback moth *Plutella xylostella* (L.) (Lepidoptera: Plutellidae). *J. of Appl. Entomol.*, **116** (1): 80-89.
28. **Yan-qing, LV., Mei-qiong,** XIE., **Yu-rong,** HE**. and CHEN Ke-wei 2011**. Contact response of *Trichogrammatoidea bactrae* to Different components of Kairomones of *Plutella xylostella*. *J. South China Agril. Univ.* **2:** http://en.cnki.com.cn/Article en /CJFDTotal-HNNB201102008.htm.
29. **Yurong, H. Kewei, C. Xiongfei, P. 2004**. Egg parasitoids of *Plutella xylostella* in South China. *Cirad-Agritrop*: 267-273.

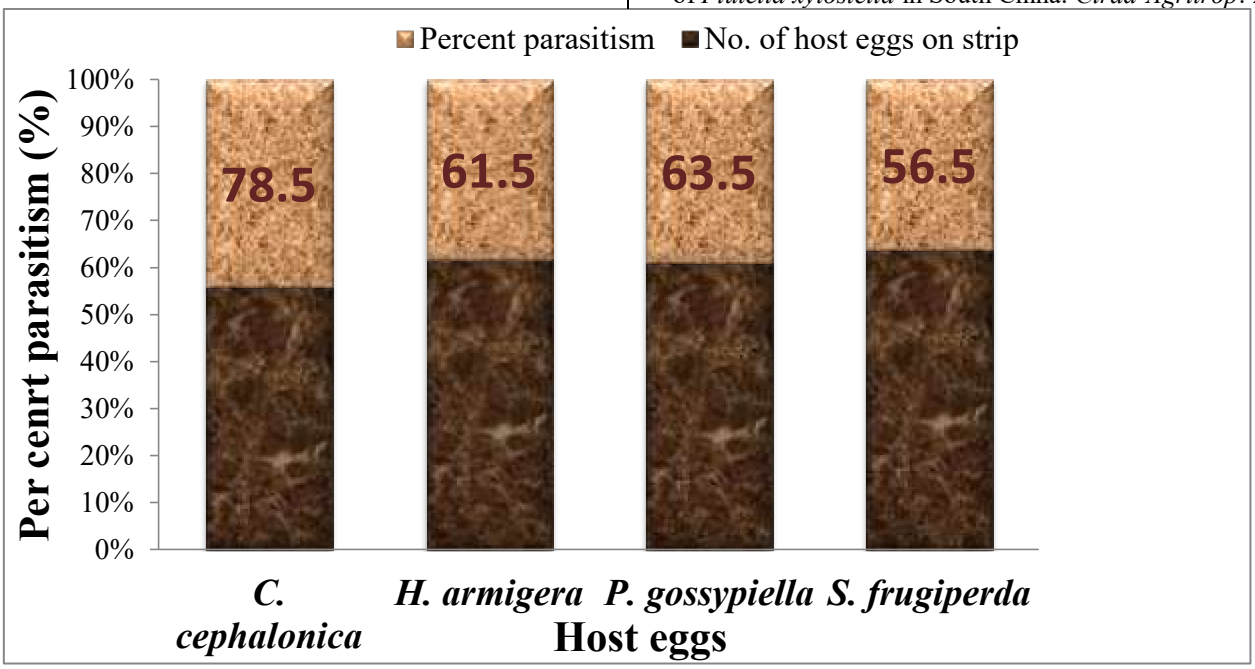

Fig. 1: Parasitic efficiency of *Tr. bactrae* on different host eggs