academicJournals

Vol. 8(25), pp. 3251-3254, 4 July, 2013
DOI: 10.5897/AJAR2013.6747
ISSN 1991-637X ©2013 Academic Journals
http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

*Full Length Research Paper*

# Reproductive parameters of *Bracon hebetor* Say on seven different hosts

**Dabhi, Manishkumar R.[1], Korat, Dhirubhai M.[2] and Vaishnav, Piyushbhai R.[3]***

[1]SRA, I.F.T.C., Directorate of Extension Education, Anand Agricultural University, Anand-388 110 (Gujarat), India.
[2]Anand Agricultural University, Anand-388 110 (Gujarat), India.
[3]Department of Agricultural Statistics, BACA, AAU, Anand-388 110 (Gujarat), India.

Accepted 24 June, 2013

**A study on reproductive parameters of *Bracon hebetor* Say on seven different hosts (Rice moth (*Corcyra cephalonica*), Stainton Angoumois grain moth (*Sitotroga cerealella)*, Oliver greater wax moth (*Galleria mellonella)*, Linnaeus spotted pod borer *(Maruca testulalis*), Geyer gram pod borer (*Helicoverpa armigera*) (Hubner), Hardwick tobacco leaf eating caterpillar (*Spodoptera litura* Fabricius) and okra fruit borer (*Earias vittella* Fabricius), studied at ordinary room temperature under laboratory conditions and revealed that *C. cephalonica* was the most suitable host for the development of *B. hebetor* among the host species tested regarding the biological parameters studied (duration of different life stages, fecundity, egg hatching percentage and sex ratio) followed by *S. cerealella, G. mellonella, M. testulalis, E. vittella, H. armigera* and *S. litura.***

**Key words:** *Bracon hebetor*, reproductive parameters, life stages, different seven hosts.

## INTRODUCTION

*Bracon hebetor* Say is a highly polyphagous gregarious ecto-parasitoid of several species of lepidopteran larvae (Magro and Parra, 2001; Jhansi and Babu, 2002; Fagundes et al., 2005; Yasodha and Natarajan, 2006; Shojaei et al., 2006; Desai et al., 2007; Kyoung et al., 2008; Mohapatra et al., 2008). It attacks a variety of important lepidopterous pests of stored product and pests of field crops (Richards and Thomson, 1932; Athanassiou and Eliopoulos, 2003; Darwish et al., 2003; Gupta and Sharma, 2004; Shojaei et al., 2006). This is a well known parasitoid of several pyralid species, especially those infesting stored grains in various parts of the world. Since the biology of parasitoid differs in different hosts (Landge et al., 2009), it becomes imperative to determine the most suitable host for its mass rearing program. Comparative biology of *B. hebetor* on different lepidopteran hosts has been studied in former papers (Margo and Parra, 2001; Jhansi and Babu, 2003; Landge et al., 2009). No such attempt has been made by any researchers in Gujarat to determine the best lepidopteran host for its rearing. With this intention we compared the reproductive parameters of *B. hebetor* on different hosts as a basis for improving mass rearing and release programs of the parasitoid in various field crops.

## MATERIALS AND METHODS

A study was made on reproductive parameters of *B. hebetor* on seven different hosts (Rice moth (*Corcyra cephalonica*), Stainton Angoumois grain moth (*Sitotroga cerealella)*, Oliver greater wax moth (*Galleria mellonella)*, Linnaeus spotted pod borer *(Maruca testulalis*), Geyer gram pod borer (*Helicoverpa armigera*) (Hubner),

*Corresponding author. E-mail: dabhimr2004@yahoo.co.in.

**Table 1.** Development time (days) of different life-stages of *B. hebetor* reared on seven different hosts.

| S/N | Host species | Egg | Larva | Pre-pupa | Pupa | Adult | | Female | | | Total life cycle | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Male | Female | Pre-oviposition | Oviposition | Post oviposition | Male | Female |
| 1 | *Corcyra cephalonica* Stainton | 0.91 | 2.66 | 0.84 | 3.71 | 9.33 | 31.76 | 0.64 | 28.41 | 4.57 | 15.28 | 44.30 |
| 2 | *Galleria mellonella* Linn. | 1.12 | 3.33 | 0.93 | 4.64 | 8.27 | 24.12 | 0.74 | 24.89 | 4.81 | 13.36 | 36.94 |
| 3 | *Sitotroga cerealella* Oliver | 0.97 | 2.84 | 0.91 | 3.86 | 8.62 | 26.72 | 0.66 | 26.16 | 4.21 | 14.22 | 41.12 |
| 4 | *Spodoptera litura* Fab. | 1.68 | 3.09 | 1.22 | 5.92 | 5.09 | 16.02 | 0.86 | 15.76 | 3.07 | 8.72 | 20.56 |
| 5 | *Maruca testulalis* Geyer | 1.28 | 3.42 | 0.98 | 5.69 | 7.39 | 22.61 | 0.69 | 23.98 | 5.38 | 10.72 | 31.32 |
| 6 | *Earias vittella* Fab. | 1.63 | 3.16 | 1.02 | 4.04 | 6.15 | 23.80 | 0.71 | 19.55 | 4.14 | 13.12 | 29.76 |
| 7 | *Helicoverpa armigera* (Hubner) Hardwick | 1.43 | 3.84 | 1.08 | 5.06 | 6.73 | 20.92 | 0.73 | 19.87 | 3.79 | 10.50 | 27.64 |
| | SEM ± | 0.05 | 0.17 | 0.05 | 0.21 | 0.31 | 0.68 | - | 0.48 | 0.15 | 0.40 | 1.01 |
| | lsd $_{0.05}$ | 0.15 | 0.48 | 0.15 | 0.62 | 0.89 | 1.98 | NS | 1.40 | 0.45 | 1.15 | 2.94 |
| | C. V. (%) | 9.29 | 11.64 | 11.99 | 10.20 | 9.36 | 6.44 | - | 4.77 | 8.04 | 7.26 | 6.85 |

NS = Not significant.

Hardwick tobacco leaf eating caterpillar (*Spodoptera litura* Fabricius) and okra fruit borer (*Earias vittella* Fabricius) studied at ordinary room temperature under laboratory conditions at Biological Control Research Laboratory, Anand Agricultural University, Anand, during 2008. Initial cultures of host larvae were collected from fields and were reared on their respective natural food to obtain healthy and uniform aged (fourth instar) larvae. The mouth of glass jar (15 cm height x 9 cm diameter) containing newly emerged 10 males and 10 females of *B. hebetor* was covered with a piece of white muslin cloth over which 10 full grown larvae of respective hosts were placed. After placing the larvae on the mouth of glass jar again another piece of white muslin cloth of same size was placed over the host larvae and kept in position with the help of rubber bands. Five replicates were used for each host species. After 24 h the parasitized larvae of each host species were removed gently without damage and were kept individually in plastic bowls (4.50 cm height x 3.50 cm diameter) for further study on various biological parameters of *B. hebetor*. The life expectancy of various life stages of *B. hebetor* reared on different hosts are presented in Table 1, whereas the reproductive data on egg hatching (%), fecundity and sex ratio are presented in Table 2. Data on egg hatching and fecundity were analyzed after arc sine and square root transformed values, respectively.

## RESULTS

The lowest life expectancy for the egg period of *B. hebetor* was registered with *C. cephalonica* followed by *S. cerealella* larvae as compared to rest of the larvae used for rearing (Table 1). *Maruca testulalis* and *H. armigera* were not significantly different in their duration of egg-period. Among the seven species of host larvae evaluated for comparative biology of *B. hebetor,* significantly longest egg period was recorded in *S. litura* followed by *E. vittella*. Highest number of *B. hebetor* eggs were hatched (Table 2) when it was reared on the larvae of *C. cephalonica* followed by *S. cerealella* and *G. mellonella*.

Lowest hatching percentage was registered in case of *S. litura* over rest of the host larvae evaluated, except *E. vittella*. Significantly, more time was required to complete its duration in case of *H. armigera* in comparison to rest of the host larvae used, except *M. testulalis*. Lowest duration was registered in case of *C. cephalonica* followed by *S. cerealella*. *S. litura*, *E. vittella* and *G. mellonella* exhibited same duration of larvae. Pre-pupal period of *B. hebetor* was found to be highest in case of S*. litura* followed by *H. armigera* and *E. vittella*. Significantly less duration of pre-pupa was registered in *C. cephalonica*, *S. cerealella*, *G. mellonella* and *M. testulalis* in comparison to *S. litura*. Pupal period was lowest in case of *C. cephalonica* followed by *S. cerealella* and *E. vittella*. Shorter pupal period was exhibited in these three larval hosts over rest of the host larvae used, except *G. mellonella.*

Among the different hosts, significantly less duration of male longevity was registered in case of *S. litura*. Not significantly different longevity was recorded in *E. vittella* and *H. armigera*. Highest duration was recorded in *C. cephalonica* followed by *S. cerealella* and differed significantly from rest of the larvae, except *G. mellonella*. As like male longevity, female longevity was also found to be highest in case of *C. cephalonica*. *S. cerealella* stood second in rank by exhibiting 26.72 days as

**Table 2.** Influence of seven different hosts on egg hatching, fecundity and sex ratio of *B. hebetor.*

| S/N | Host species | Egg hatching (%) | Fecundity | Sex ratio (F : M) |
|---|---|---|---|---|
| 1 | *Corcyra cephalonica* Stainton | *66.92 (75.34) | 12.44 (154.25)** | 1 : 1.32 |
| 2 | *Galleria mellonella* Linn. | 63.41 (70.45) | 11.55 (132.90) | 1 : 1.64 |
| 3 | *Sitotroga cerealella* Oliver | 66.66 (74.99) | 12.12 (146.39) | 1 : 1.56 |
| 4 | *Spodoptera litura* Fab. | 55.69 (58.89) | 8.61 (73.63) | 1 : 1.77 |
| 5 | *Maruca testulalis* Geyer | 62.08 (68.52) | 10.47 (109.12) | 1 : 1.67 |
| 6 | *Earias vittella* Fab. | 59.42 (64.68) | 10.85 (117.22) | 1 : 1.60 |
| 7 | *Helicoverpa armigera* (Hubner) Hardwick | 60.75 (66.57) | 10.10 (101.51) | 1 : 1.70 |
| | SEM ± | 1.66 | 0.08 | 0.05 |
| | lsd $_{0.05}$ | 4.79 | 0.23 | 0.13 |
| | C. V. (%) | 5.92 | 1.66 | 6.23 |

* Arc sin transformed values; **, $\sqrt{x + 0.5}$ transformed values; Figures in parenthesis are retransformed values.

female longevity. Both these larval hosts differed from rest of larvae by registering significantly higher longevity over remaining host larvae. On the other hand significantly less duration was recorded on *S. litura. Maruca testulalis, E. vittella* and *G. mellonella* exhibited not significantly different in longevity and were at par. Pre-oviposition period was found to be 0.64 to 0.86 day on different host larvae and there was no significant difference among the hosts used. Relatively less pre-oviposition period was found in case of *C. cephalonica* and *S. cerealella*. Significantly highest and lowest oviposition period was recorded in *C. cephalonica* and *S. litura,* respectively. With respect to oviposition period, *E. vittella* and *H. armigera* performed equally. Similarly, *G. mellonella* and *S. cerealella* exhibited not significantly different in duration of oviposition. Significantly, highest post-oviposition period was registered in *M. testulalis* than other host larvae. *G. mellonella* stood second in position by registering 4.81 days as oviposition period. On the other hand, *S. litura* exhibited significantly lowest duration of post-oviposition. With respect to post-oviposition period, *C. cephalonica*, *S. cerealella* and *E. vittella* were at par. *B. hebetor* larvae reared on different hosts influenced significantly on egg-laying potential (Table 2). Significantly highest fecundity was registered in case of *C. cephalonica* followed by *S. cerealella*. On the other hand, significantly least number of eggs per female were recorded in *S. litura* followed by *H. armigera*. *M. testulalis*, *E. vittella* and *G. mellonella* exhibited fecundity ranging from 109.12 to 132.90 eggs/ female.

Highest duration to complete one life-cycle (egg to adult) of *B. hebetor* female was recorded in *C. cephalonica* followed by *S. cerealella*. Both these host larvae differed from remaining hosts by exhibiting significantly higher duration. Significantly lowest period for one life-cycle of female was found in *S. litura*. In terms of life-period, *H. armigera* and *E. vittella* were found to be not significantly different and were at par. Similar trend to complete whole life-cycle on different host larvae was noticed in male insects. Highest duration was registered in case of *C. cephalonica* followed by *S. cerealla*. Among the different hosts, lowest duration of male life-cycle was recorded in *S. litura*. Sex ratio (Female : Male) of *B. hebetor* reared on different host larvae revealed that minimum male population of the parasitoid was registered in case of *C. cephalonica* followed by *S. cerealella* . On the other hand, highest male ratio was predominated when the *B. hebetor* was reared on *S. litura* followed by *H. armigera*. Ratio of female to male was not significantly different in case of *G. mellonella*, *M. testulalis* and *E. vittella* (Table 2).

## DISCUSSION

Lowest egg period of *B. hebetor* was registered in *C. cephalonica* followed by *S. cerealella* and *G. mellonella*. This finding agrees with Forouzan et al. (2003) who reported that the average egg period was 1.77 ± 0.03 days in *G. mellonella.* Highest numbers of *B. hebetor* eggs were hatched when it was reared on the larvae of *C. cephalonica* followed by *S. cerealella* and *G. mellonella*. Results of higher (6.82%) percentage of egg hatch on *C. cephalonica* over *M. testulalis* noticed in present study agree with the manuscript of Jhansi and Babu (2003). Larval duration of *G. mellonella* was found as 3.33 days which was not significantly different (3.43 ± 0.04 days) as reported earlier by Forouzan et al. (2003). Pupal period was lowest in case of *C. cephalonica* followed by *S. cerealella, E. vittella* and *G. mellonella*. This finding agrees with Forouzan et al. (2003) who reported that the average pupal period was 6.89 ± 0.05 days in *G. mellonella.*

Highest male longevity was recorded in *C. cephalonica* followed by *S. cerealella* and it was differed significantly from rest of the larvae, except *G. mellonella*. This is

similar to the values reported by Nikam and Pawar (1993). As like male longevity, female longevity was also found to be highest in case of *C. cephalonica*. *S. cerealella* stood second in rank by exhibiting 26.72 days as female longevity. This finding agrees with Youm and Gilstrap (1993) who reported that female of *B. hebetor* lived an average of 24.7 days when reared on *H. albipunctella* Joannis. Significantly highest fecundity was registered in case of *C. cephalonica* followed by *S. cerealella.* This was not significantly different values (173.7 eggs/female) were found on *H. albipunctella* de Joannis by Youm and Gilstrap (1993). On the other hand, significantly least numbers of eggs per female were recorded in *S. litura* followed by *H. armigera*. *M. testulalis*, *E. vittella* and *G. mellonella* exhibited fecundity ranging from 109.12 to 132.90 eggs/ female. Xie et al. (1989) recorded more number of *B. hebetor* eggs on larger larvae than smaller host larvae which corroborates with the present finding in which significantly higher fecundity of the parasitoid was revealed on larger sized larvae of *C. cephalonica* over *S. cerealella*. In the present study, significantly more number of eggs were laid by females of *B. hebetor* as compared to *M. testulalis* which agree with the results of Jhansi and Babu (2003). Sex ratio (Female : Male) of *B. hebetor* reared on different host larvae revealed that minimum male population of the parasitoid was registered in case of *C. cephalonica* followed by *S. cerealella*. On the other hand, highest male ratio was predominated when the *B. hebetor* was reared on *S. litura* followed by *H. armigera*. Comparatively higher number of females than males was recorded by Jhansi and Babu (2003) on *C. cephalonica* in comparison to *M. testulalis* is contradictory with the present finding. This discrepancy might be due to the variation in food and climatic condition in which the study has been made. None of earlier worker has studied the reproductive parameters of *B. hebetor* on different species of lepidopterous as hosts evaluated in present study except *C. cephalonica, S. cerealella, G. mellonella* and *M. testulalis.*

From the above results it can be concluded that *C. cephalonica* found to be the best host for laboratory mass rearing of *B. hebetor* followed by *S. cerealella*. This finding is supported by few earlier studies. According to Zohdy (1979), *C. cephalonica* found to be the most suitable host for the development of *B. hebetor*. Jhansi and Babu (2003) reported that with respect to number of eggs laid, percentage of egg hatch, growth index and percentage of adult emergence, *C. cephalonica* found better host than *M. testulalis*. Landge et al. (2009) also revealed superiority of *C. cephalonica* over *Opisina arenosella* Walker.

**REFERENCES**


Athanassiou CG, Eliopoulos PA (2003). Seasonal abundance of insect pests and their parasitoids in stored currants. Bulletin-OILB/SROP 26:283-291.

Darwish E, El-Shazly M, El-Sherif H (2003). The choice of probing sites by *Bracon hebetor* Say foraging for *Ephestia kuehniella* Zeller. J. Stored Prod. Res. 39:265-276.

Desai VS, Nagwekar DD, Patil PD, Narangalkar AL (2007). Field evaluation of a larval parasite *Bracon hebetor* Say against coconut black headed caterpillar. J. Plantation Crops. 35:188-189.

Fagundes GG, Mohamed H, Solis DR (2005). Biological responses of *Anagasta kuehniella* and its parasitoid, *Bracon hebetor*, to microwaves radiation (2450 MHz). Revista de Agricultura Piracicaba. 80:12-34.

Forouzan M, Sahragard A, Amirmaafi M (2003). Study on the biology of *Habrobracon hebetor* Say under laboratory conditions. J. Entomol. Soc. Iran 22:63-76.

Gupta S, Sharma HB (2004). *Bracon hebetor* Say is the natural enemy of *Ephestia calidella* (Guen.) a pest of stored dry fruits. Uttar Pradesh J. Zool. 24:223-226.

Jhansi K, Babu PCS (2002). Life table studies of *Bracon hebetor* (Say) on *Corcyra cephalonica* (Stainton) and *Maruca testulalis* (Geyer) under laboratory conditions. J. Appl. Zool. Res. 13:22-24.

Jhansi K, Babu PCS (2003). Comparative biology of *Bracon hebetor* Say in two host insects. J. Appl. Zool. Res. 14:165-168.

Kyoung DJ, Ha DH, Nho SK, Song KS, Lee KY (2008). Up regulation of heat stock protein genes by envenomation of ectoparasitoid *Bracon hebetor* in larval host of Indian meal moth, *Plodia interpunctella*. J. Invertebrate Pathol. 97:306-309.

Landge SA, Wakhede SM, Gangurde SM (2009). Comparative biology of *Bracon hebetor* Say on *Corcyra cephalonica* Stainton and *Opisina arenosella* Walker. Int. J. Plant Protect. 2:278-280.

Margo SR, Parra JRP (2001). Biology of the ectoparasitoid *Bracon hebetor* Say on seven lepidopteran species. Scientia Agricola. 58:693-698.

Mohapatra SD, Duraimurugan P, Saxena H (2008). Natural parasitization of *Maruca vitrata* (Geyer) by *Bracon hebetor* Say. Pulses Newsl. 19:11.

Nikam PK, Pawar CV (1993). Life tables and intrinsic rate of natural increase of *Bracon hebetor* Say population on *Corcyra cephalonica* Staint., J. Appl. Entomol. 115:210-213.

Richards OW, Thompson WS (1932). A contribution to the study of genera *Ephestia* (including Strymax, Dyar) and *Plodia interpunctella*, with notes on parasite of the larvae. Trans. Entomol. Soc. London 80:169-247.

Shojaei S, Safaralizadeh M, Shayesteh N (2006). Effect of temperature on the functional response of *Habrobracon hebetor* Say to various densities of the host, *Plodia interpunctella* (Hubner). Pak. Entomol. 28:51-55.

Xie ZN, Li L, Xie YQ (1989). In vitro culture of *Habrobracon hebetor* (Say). Chinese J. Biol. Control. 5:49-51.

Yasodha, P, Natarajan N (2006). Diversity of natural enemies of *Leucinodes orbonalis* Guenee. *Entomon*, 31:323-326.

Youm O, Gilstrap FE (1993). Population dynamics and parasitism of *Coniesta (Haimachia) ignefusalis*, *Sesamia calamistis* and *Heliocheilus albipunctella* in millet monoculture. Insect Sci. Appl. 14:419-426.

Zohdy NZM (1979). Host selection and host suitability of *Bracon hebetor* Say. Bull. Fac. Sci. Cairo Uni. 48:301-314.