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Comparative biology of *Bracon hebetor* Say on seven lepidopteran hosts*

Bracon hebetor Say (Braconidae: Hymenoptera) is a highly polyphagous gregarious ecto-parasitoid of several species of lepidopterous larvae including pyralidae. It attacks a variety of important lepidopterous pests of stored product and pests of field crops. 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 programme. Information on comparative biology of *B. hebetor* on different lepidopteran hosts is meagre. No such attempt has been made by any researchers in Gujarat to determine the best lepidopteran host for its rearing and hence the present study was undertaken.

Biology of *B. hebetor* on seven lepidopteran hosts (rice moth, *Corcyra cephalonica* Stainton, Angoumois grain moth, *Sitotroga cerealella* Oliv., greater wax moth, *Galleria mellonella* Linn., spotted pod borer, *Maruca testulalis* Geyer, gram pod borer, *Helicoverpa armigera* (Hubner) Hardwick, tobacco leaf eating caterpillar, *Spodoptera litura* Fab. and okra fruit borer, *Earias vittella* was studied at ordinary room temperature (27 + 10^0C) under laboratory conditions at Biological Control Research Laboratory, Anand Agricultural University, Anand during 2008. Initial cultures of host larvae were collected from fields and reared on their respective natural food to obtain healthy and uniform aged larvae. The mouth of glass jar (15 cm x 9 cm) containing adults of *B. hebetor* was covered with a piece of white muslin cloth (14cm x 14 cm size) over which 10 full grown larvae of respective hosts were placed. After placing the larvae on 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. Such five sets were used in each case. After one day, the parasitized larvae of respective host were removed gently and kept individually in plastic bottle (4.50 cm x 3.50 cm) for further study on various biological parameters of *B. hebetor.* The data on duration of various life stages of *B. hebetor* reared on different hosts are presented in Table 1, whereas the data on egg hatching (%), fecundity and sex ratio are presented in Table 2.

Data (Table 1) indicated that significantly minimum (0.91 day) egg period of *B. hebetor* was registered in *C. cephalonica* as compared to rest of the larvae used for rearing, except *S. cerealella. M. testulalis* and *H. armigera* exhibited more or less same duration of egg-period. Significantly longest (1.68 days) egg period was recorded in *S. litur*a followed by *E. vittella.* Maximum (75.34 %) number of *B. hebetor* eggs were hatched (Table 2) when it was reared on *C. cephalonica* followed by *S.cerealella* and *G. mellonella*. On the other hand, significantly minimum (58.89 %) hatching percentage was registered in *S. litura* over rest of the host larvae evaluated, except *E.vittella*. Higher percentage of egg hatch on *C. cephalonica* over *M. testulalis* noticed in present study corroborates with the report of Jhansi and Babu (2003). Significantly more time required to complete its duration in *H. armigera* in comparison to rest of the host larvae used, except *M. testulalis*. Minimum duration (2.66 days) was registered in *C. cephalonica* followed by *S. cerealella* . *S. litura, E. vittella* and *G. mellonella* exhibited more or less same duration of larvae. Pre-pupal period of *B. hebetor* was found to be maximum (1.22 days) in *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 minimum (3.71 days) in C. cephalonica followed by *S. cerealella* and *E. vittella.* Significantly less pupal period was exhibited in these three larval hosts over rest of the host larvae used, except *G. mellonella*.

Significantly least (5.09 days) duration of male longevity was registered in *S. litura,* whereas maximum duration was recorded in *C. cephalonica* followed by *S. cerealella* and differed significantly from rest of the larvae, except *G. mellonella.* Female longevity was also found to be maximum (31.76 days) in *C. cephalonica* followed by *S. cerealella*. Both these hosts registered significantly higher longevity over remaining hosts. On the other hand significantly least (16.02 days) duration was recorded on *S.litura. M. testulalis, E. vittella* and *G. mellonella* exhibited more or less same (22.61 to 24.12 days) longevity and were at par. With respect to pre-oviposition period, there was no significant difference among the hosts used. Significantly

Table 1. Duration (days) of different life-stages of *Bracon hebetor* reared on lepidopteran hosts

Hosts	Egg	Larva	Pre-pupa	Pupa	Adult		Female			Total life cycle	
					Male	Female	pre-oviposition	oviposition	Post oviposition	Male	Femae
C.cephalonica	0.91	2.66	0.84	3.71	9.33	31.76	0.64	28.41	4.57	15.28	44.30
S. cerealella	0.97	2.84	0.91	3.86	8.62	26.72	0.66	26.16	4.21	14.22	41.12
G. mellonella	1.12	3.33	0.93	4.64	8.27	24.12	0.74	24.89	4.81	13.36	36.94
M. testulalis	1.28	3.42	0.98	5.69	7.39	22.61	0.69	23.98	5.38	10.72	31.32
H. armigera	1.43	3.84	1.08	5.06	6.73	20.92	0.73	19.87	3.79	10.50	27.64
S.litura	1.68	3.09	1.22	5.92	5.09	16.02	0.86	15.76	3.07	8.72	20.56
E. vittella	1.63	3.16	1.02	4.04	6.15	23.80	0.71	19.55	4.14	13.12	29.76
S.Em±	0.05	0.17	0.05	0.21	0.31	0.68	-	0.48	0.15	0.40	1.01
C.D @5%	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

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Table 2. Influence of various lepidopteran hosts on egg hatching, fecundity and sex ratio of *Bracon hebetor*

Hosts	Egg hatching (%)	Fecundity	Sex ratio (F : M)
C. cephalonica	*66.92 (74.34)	12.44 (154.25)**	1 : 1.32
S. cerealella	66.66 (74.99)	12.12 (146.39)	1 : 1.56
G. mellonella	63.41 (70.45)	11.55 (132.90)	1 : 1.64
M. testulalis	62.08 (68.52)	10.47 (109.12)	1 : 1.67
H. armigera	60.75 (66.57)	10.10 (101.51)	1 : 1.70
S.litura	55.69 (58.89)	8.61 (73.63)	1 : 1.77
E. vittella	59.42 (64.68)	10.85 (117.22)	1 : 1.60
S. Em ±	1.66	0.08	0.05
C.D @5%	4.79	0.23	0.13
C.V. (%)	5.92	1.66	6.23

* Arcsine transformed values

** $\sqrt{x + 0.5}$ transformed values

Figures in parentheses are retransformed values.

highest (28.41 days) and lowest (15.76 days) oviposition period was recorded in *C. cephalonica* and *S. litura*, respectively. Similarly, *G. mellonella* and *S. cerealella* exhibited more or less same (24.89 to 26.16 days) duration of oviposition. Significantly highest (5.38 days) post-oviposition period was registered in *M. testulalis* than other host larvae. On the other hand *S. litura* exhibited significantly minimum (3.07 days) duration of post-oviposition.*B.hebetor* larvae reared on different hosts influenced significantly on egg-laying potential (Table 2). Significantly highest (154.25 eggs/female) fecundity was registered in *C. cephalonica* followed by *S. cerealella* whereas significantly least (73.63) number of eggs per female were recorded in *S. litura* followed by *H. armigera*. Xie *et al.* (1989) recorded more number of *B. hebetor* eggs on larger larvae than smaller 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*. From results it evident that significantly more number of eggs laid by females of *B. hebetor* as compared to *M. testulalis* which is in agreement with the results of Jhansi and Babu (2003).

Maximum duration (44.30 days) to complete one life-cycle of *B. hebetor* female was recorded in *C.cephalonica* followed by *S. cerealella*. Both the hosts differed from remaining hosts by exhibiting significantly higher duration. Significantly minimum (20.56 days) period for one life-cycle of female was found in *S. litura*. With respect to life cycle, *H. armigera* and *E. vittella* were found more or less same and were at par. Similar trend to complete whole life-cycle on different host larvae was noticed in male insects. Sex ratio (Female: Male) of *B. hebetor* reared on different host larvae revealed that minimum male population was registered in C. cephalonica (1:1.32) followed by *S. cerealella* (1:1.56). Male population was predominated (1:1.77) when the *B. hebetor* reared on *S. litura* followed by *H. armigera*. Ratio of female to male was more or less same (1:1.64 to 1:1.68) in *G. mellonella*, *M. testulalis* and *E. vittella* (Table 2). Comparatively higher number of females than males 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.

From the above, it can be concluded that the *C. cephalonica* was found to be the best host for mass rearing followed by *S. cerealella*. This finding supported by the report of Zohdy (1979). 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. These reports are in conformity with the present finding.

AICRP on Biological Control of Crop Pests and Weeds
Anand Agricultural University, Anand-388 110, India
Email : dm_korat@yahoo.co.in

M. R. DABHI
D. M. KORAT
P. R. VAISHNAV

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