The Bioscan 12(1): 193-197, 2017
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

EFFECT OF DIFFERENT INSECT HOSTS ON BIOLOGY AND PREDATION EFFICIENCY OF *EOCANTHECONA FURCELLATA* WOLFF (HEMIPTERA: PENTATOMIDAE)

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KEYWORDS
Biology
Corcyra cephalonica
Eocanthecona furcellata
Percent predation
Spodoptera litrua

Received on :
11.10.2016

Accepted on :
07.01.2017

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ABSTRACT
Eocanthecona furcellata (Wolff.) (Hemiptera: Pentatomidae) is an important predator for several agriculturally important insect pests. Laboratory experiments were conducted to find out the impact of different lepidopteran hosts on the biology and predation efficiency of *E. furcellata*. The analyses showed that minimum life period (31.33 ± 0.57 days) of *E. furcellata* was recorded on larvae of *Corcyra cephalonica* with lowest no. of egg laying (32.33 ± 3.05 eggs) followed by 37.33 ± 3.21 days on *Maruca virata* with 43.66 ± 4.72 eggs and longest life span (39.33 ± 2.30 days) was recorded on *Spodoptera litura* with maximum egg lay of 58.00 ± 5.29 eggs. The maximum 85.94% predation was recorded on larvae of *M. vitrata* followed by 84.49% on larvae of *C. Cephalonica*. Results revealed that *M. vitrata*, *S. litura* and *C. cepahlonica* were found to be suitable host and larvae of Spilarctia obliqua was not reported as preferred host of the *E. furcellata*. There fore, *E. furcellata* could be utilised effectively against *M. vitrata* under field conditions, moreover, *S. litura* and *C. cephalonica* could be employed as laboratory hosts for mass rearing of *E. furcellata*.

INTRODUCTION

Pest control with natural enemies has been increasing due to environmental, economical, social and ecological problems with insecticides. Hence, Biological control is recognized as one of the best alternatives for controlling insect pests. Insect predators and parasitoids are the most important naturally occurring biological control agents of insect and mite pests in most of the crop ecosystems. Among them a heteropteran predator, *Eocanthecona furcellata* (Wolff.) (Hemiptera: Pentatomidae) is important biological control agents of many Lepidopteron, Coleopteran and Heteropteran insects (Chang, 2002). The predatory bug *E. furcellata* is found especially in pigeon pea, chickpea, soybean, urd-mung and vegetable fields and has been found preying on larvae of pod borers, spotted pod borer, tobacco caterpillars and hairy caterpillars (Yi and Kyi, 2000, Nyunt, 2001, Nabapure and Agnihotri, 2011). *E. furcellata* has also been reported from paddy (Sharma *et al.*, 2015) and forest ecosystem (Aland *et al.*, 2010). Hence, keeping the abundance and potential of this predator, it can be used as an important biological control agent in integrated pest management programme in many crop ecosystems. However, data on his efficacy or on prey preferences are scattered. Thus studies on the biology and predation efficiency of *E. furcellata* were conducted on different hosts *viz*., *Maruca vitrata, Spodoptera litura, Spilarctia obliqua, Cocyra cepahlonica* under laboratory condition to find out its preferred host, with the intention that the same could be utilised for the mass rearing.

MATERIALS AND METHODS

The experiment was conducted in Biological Control Laboratory, Department of Entomology during 2015-16. Initial culture of the predator was started through field collected eggs of *E. furcellata*. The each egg masses were counted and tagged to *Solanum nigrum* plants as initial food for I instar nymphs of predator. The tagged plants were placed in plastic trays till they hatched and complete its 1st instar (Gupta *et al.*, 2004). 2nd instar onwards all nymphs were counted and maintained in different plastic trays by providing the 10 larvae of each host at a time. The experiment was replicated thrice. The number of consumed larvae was recorded daily and fresh larvae were provided for further feeding. Predation by each nymphal stage of predator was recorded on different hosts. The stock cultures of different hosts were maintained in laboratory on their respective host isects and artificial diet at temperature 32 ± 2 ºC, 75 ± 5% relative humidity and 12 ± 1 hrs photoperiod (Lenin and Rajan, 2016). For *Maruca vitrata* plastic container was used in which first and second instars larvae were fed with flower buds and flowers and later instars provided with flowers and tender pods of pigeonpea. In case of *Spodoptera litura* stock culture was maintained on artificial diet. The diet was prepared by grinding Kabuli gram flour, methyl-para-hydroxy benzoate, yeast powered and ascorbic acid. Agar –agar was used for solidifying the diet (Shorey and Hale, 1965). To maintain the stock of *Spilarctia obliqua,* larva was manually collected from the field and placed in plastic

tub with fresh leaves of soybean. The laboratory culture of *C. cephalonica* was maintained as per the method described by Kumar *et al.*, (2005) under the laboratory conditions. 150-200 eggs of *C. cephalonica* were mixed with one and half kilogram of milled maize in jars daily upto 20 days, then the jars was covered with muslin cloth. The larvae fed on milled maize and moulted then pupated. Adults were emerged after 45-50 days and laid eggs. Then collected eggs were allowed to hatch. The larvae were used for further experiment.

The data on the different nymphal period, adult period, number of eggs laid and number of host's larvae consumed at each stage of predatory bug were recorded. The data obtained were subjected to statistical analysis as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Biology of *E. furcellata* on larvae of different hosts

Observation on the biology of *E. furcellata* on the larvae of *S. litura, M. vitrata, S. obliqua and C. cepahlonica* revealed that the life cycle of *E. furcellata* passed through five nymphal instars with a total nymphal period of about 22.00 ±1.00, 20.67± 1.53, 10.33±0.57 and 24.33± 0.57 days, respectively on different hosts (Table 1). The duration for first instar nymph did not showed much variation as it feeds on plant secretions and were reared on plants of *Solanum nigrum*. However, the

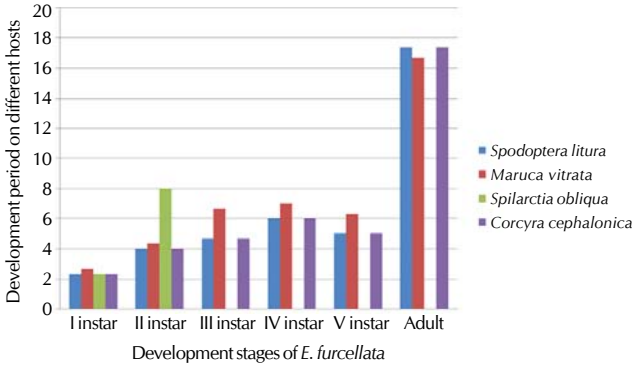

Figure 1: Effect of different host on the biology of predatory bug, *E. furcellata*

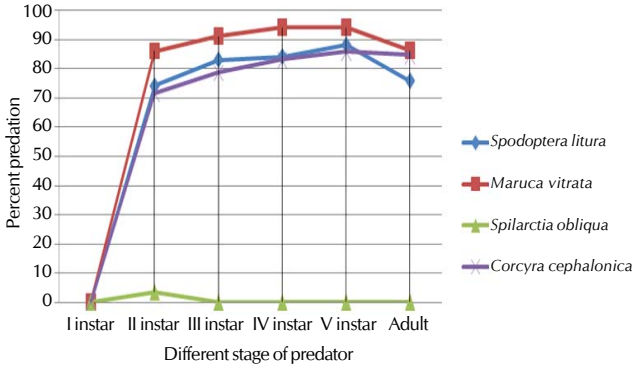

Figure 2: Effect of different hosts on per cent predation of *E. furcellata*

Table 1 : Effect of different hosts on the biology of predatory bug, *Eocanthecona furcellata*.

Host Insects	Predator Stages No. Eggs released	No. of eggs hatched	Nymphal period (in days) I	II	III	IV	V	Total Nymphal period(in days)	Adults Period (in days)	Total period of Life cycle (in days)	Total No. of egg laid	Incubation period (in days)
Spodoptera litura	40.33±7.23	38.66±9.50	2.33±0.57	4.00±1.00	4.66±1.15	6.00±1.00	5.00±1.00	22.00±1.00	17.33±1.52	39.33±2.30	58.00±5.29	5.66±0.57
Maruca vitrata	50.33±3.21	48.33±3.21	2.66±0.57	4.33±1.52	6.67±0.57	7.00±0.0	6.33±1.52	20.67±1.53	16.67±2.08	37.33±3.21	43.66±4.72	7.00±1.00
Spilarctia obliqua	40.33±5.50	37.66±4.93	2.33±0.57	8.00±1.00	-**	-	-	-	-	-	-	-
Corcyra cephalonica	40.33±5.03	38.33±5.68	2.33±0.57	4.33±1.00	4.00±1.0	6.67±1.52	7.33±1.15	24.33±0.57	7.00±1.00	31.33±0.57	32.33±3.05	5.33±0.57

* Values represent means ±SD of three replications;** The host was not preferred by the predator, hence, development was not observed on *S. obliqua* larvae.

Table 2 : Study on the predatory efficiency of the predatory bug, *Eocanthecona furcellata* on different hosts

Predatory Stages	Per cent prey Consumption			
	Spodoptera litura	*Maruca vitrata*	*Spilarctia obliqua*	*Cocyra cephalonica*
Nymphal instar I	No feeding	No feeding	No feeding	No feeding
Nymphal instar II	74.00 (59.39)*	85.88 (67.96)	3.50 (10.63)	71.49 (57.76)
Nymphal instar III	82.89 (65.62)	90.85 (72.67)	No feeding	78.61(62.46)
Nymphal instar IV	83.99 (66.47)	93.98 (76.08)	No feeding	83.00(65.73)
Nymphal instar V	88.00 (69.85)	93.98 (76.08)	No feeding	85.66(67.79)
Adult	75.67 (60.68)	85.94 (68.22)	No feeding	84.49(66.92)
SEm ±	-1.98	-1.91	-0.63	-1.3
CD (0.05)	-6.12	-5.9	-1.94	-3.99

*Figures mentioned in the parenthesis are angular transformed values

Figure 3 : Different stages of *Eocanthecona* bug. A. Egg mass; B. Second nymhal instar; C. Third nymphal instar; D. Fourth nymhal instar; E. Fifty nymphal instar; F. Adult

I instar nymphal period was ranged from 2.33 ± 0.57 days to 2.66 ± 0.57 days on all the four insect hosts. After second instar, the nymphs were started feeding on the host insects. The maximum nymphal period (8.00 ± 1.00 days) of predator was observed on *S. obliqua*, where as, on all three host insects there were no significant difference recorded and II nymphal periods lie between 4.00 ± 1.00 to 4.33 ± 1.52 days. Results revealed that second instars onwards the *S. obliqua* was not preferred by *E. furcellata* and host was rejected by predator. The results were in contrary to Kumar *et al*. (2001) who reported *S. obliqua* as a preferred host of *E. furcellata*. The longest third nymphal period was recorded on *Maruca,* whereas, predator took minimum 4.00 ± 1.00 days to complete third instar on *C. cephalonica*. The predator had taken maximum 7.00 ± 0.0 days to complete its fourth instar on the *Maruca* larvae, while, minimum 6.00 ± 1.00 days on *S. litrua* larvae. For the fifth instar, maximum period (7.33 ± 1.15 days) was recorded on *C. cephalonica* larvae and minimum nymphal period (5.00 00 ± 1.00 days) was observed on *S. litura*. As whole the maximum cumulative nymphal period *i.e.* 24.33 ± 0.57 days was recorded on larvae of *C. cephalonica*, where as, minimum cumulative nymphal period (20.67 ± 1.53 dyas) was reported on the larvae of *Maruca*. On *S. litura,* the cumulative nymphal period was 22.00 ± 1.00 days. The present finding is accordance with Kumar and Singh (2007) who also reported maximum nymphal period of 16.78 days on *S. litura* followed by 15.27, 15.20, 14.50, 14.36 and14.13 days on *S. obliqua, C. medinalis, C. cephalonica, A. merione* and *C. fulgurita*, respectively. In case of Adult life span, the maximum adult period (17.33 ± 1.52 days) was

recorded on *S. litura*, whereas, minimum adult period *i.e.* 7.00 ±1.00 days was observed on *C. cephalonica* as compare to 16.67±2.08 days adult period on *Maruca*. Pillai and Agnihotri (2013) reported adult longevity of male and female were 13.2 days and 22.6 days, respectively on *Maruca*. The total shortest life span (31.33±0.57 days) of predator *E. furcellata* was recorded on larvae of *C. cephalonica* with lowest number of egg laying (32.33±3.05 eggs) followed by 37.33±3.21 days on *Maruca* with 43.66±4.72 eggs and longest life span (39.33±2.30 days) was recorded on *S. litura* with maximum egg laying of 58.00±5.29 eggs (Fig 1). Kumar and Singh (2007) also reported longest life period of male (27.59 days) and female (45.20 days) of *E. furcellata* on *S. litrua* Maximum egg incubation period of 7.00± 1.00 days was recorded of *Maruca vitrata* and it was followed by *S. obliqua* with 6.33 ± 1.52 days. Semillano and Corey (1992) observed incubation periods of 8 to 9 days with a mean of 8.5 ±0.162 days. On *C. cephalonica,* minimum incubation period *i.e.* 5.33 ± 0.57 days of predator was recorded, however, Kumar *et al*. (2007) reported the incubation period of *Eocanthecona* of 8.25 days when reared on *C. cephalonica,* where as, Lenin and Rajan (2016) reported incubation period 6±1.05 days and total nymphal period of about 16±0.64days with male and female longevity of 12±1.05days and 14±1.09days, respectively.

Predation efficiency of the predatory bug, *E. furcellata* on different hosts

Result in Table 2 indicated that the first instar larvae were not feeding on all the four hosts due to their zoophytophagous nature. Singh and Singh (1989) also reported that first instar of pentatomid predatory bug, *Andrallus spinidens* (Fab) do not feed on larva of its host *Rivula sp*. At second nymphal instar maximum per cent predation (85.88 per cent) was observed in *M. vitrata* followed by *S. litura* (74 per cent) and minimum per cent predation (3.50 per cent) was observed in *S. obliqua*. Pillai and Agnihotri (2013) also reported that maximum predation on second instar of *M. vitrata* 66.47 per cent by female and 58.33 per cent by male of *Eocanthecona*. Second instar onward the per cent predation showing slight increasing trend upto fifth instar for all the hosts In case of *S. obliqua* no feeding was observed because of hairy body which makes it a non preferred host for *E. furcellata* (Fig 2). Maximum per cent predation by third, fourth and fifty nymphal instar of *E. furcellata* was observed in case of *M. vitrata* 90.85 %, 93.98 % and 93.98 % , respectively and minimum of *S. obliqua* in which no feeding was observed. While, Kumar *et al*.(2001) reported maximum consumption of prey by third, fourth and fifth instar nymph of *Eocathacona*. In case of adult slight decrease in per cent predation was observed as compared to the nymphal instars of different hosts. Maximum per cent predation of 85.94 per cent was observed in adults on *M. vitrata* larvae followed by on larvae of *C. cepahlonica* with 84.49 per cent predation and 75.67 per cent predation on *S. litura* larvae. The present study is in conformity with the work done earlier by Ahmad *et al*.(1996), however, consumed as many as 115.75, 89.68, 86.53 and 159.98 *C. fulgurita* larvae, respectively. Thus, the present result clearly reflects that *E. furcellata* could safely be considered as potential bio-control agent in pest management programme of lepidopteron.

M. vitrata, *S. litura* and *C. cephalonica* found to be suitable prey with successful life cycle under laboratory conditions as well as per cent prey consumption was also observed at each nymphal instar but *S. obliqua* , was not a preferred prey of *E. furcellata* as life cycle was not completed on it with minimum per cent prey consumption. It was concluded from the result that *S. litura* and *M. vitrata* are the preferred and suitable hosts of *E. furcellata*. Tuan *et al*., 2016 also reported *S. litura* preferred and suitable host of *E. furcellata*. Hence, this predator could be utilised as effective biocontrol agent against *Maruca vitrata* under pulse ecosystems, whereas, larvae of *S. litura* and *C. cepahlonica* could be utilised as laboratory host for *E. furcellata* for mass culture.

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