ORIGINAL RESEARCH PAPER
Volume-9 | Issue-3 | March-2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

PREDATORY BEHAVIOUR OF EOCANTHECONA FURCELLATA ((HEMIPTERA: PENTATOMIDAE) FEEDING ON LARVAE OF HYPOSIDRA TALACA (LEPIDOPTERA: GEOMETRIDAE), A MAJOR TEA PEST OF NORTH EAST INDIA

Zoology

Suman Sarkar Department Of Entomology, Tea Research Association, North Bengal Regional R & D Centre, Nagrakata, Jalpaiguri, West Bengal, 735 225, India.

Azariah Babu* Department Of Entomology, Tea Research Association, North Bengal Regional R & D Centre, Nagrakata, Jalpaiguri, West Bengal, 735 225, India. *Corresponding Author

Kaushik Chakraborty Department Of Zoology, Raiganj University, Uttar Dinajpur, West Bengal, 733134, India.

Bhabesh Deka Department Of Entomology, Tea Research Association, North Bengal Regional R & D Centre, Nagrakata, Jalpaiguri, West Bengal, 735 225, India.

ABSTRACT

Eocanthecona furcellata (Wolff.) is an important predator of several pets associated with agricultural crops, especially lepidopteran pest. The predatory behaviours of this insect such as approach and attacking, paralyzing, sucking were recorded. The adult female could paralyze a larvae in 4.7±0.6 seconds and suck the body sap within 95.3±5.0 seconds. First instar nymph preferred only second instar larvae of looper and group feeding was observed. The incubation period was recorded as 7.6±1.1days and total duration of nymphal stages was 18.4±1.5days. The longevity of adult male and female were recorded as 30.0±1.9 days and 32.8±0.8 days respectively. The hatchibility rate of egg was 94.5% with 96.2% adult survival rate was recorded, when reared on *Coeryra cephalonica*. Moreover this study revealed that, in the absence of main host, *C. cephalonica* could be used as alternative host to mass rear *E. furcellata,* successfully for field release.

KEYWORDS

Predatory Behaviour, *Eocanthecona furcellata*, Tea Looper.

INTRODUCTION:

Perennial monoculture crop tea (*Camellia sinensis* L.), provides shelters, food, microenvironment for breeding for divers species of arthropod throughout the year (Babu *et al.,* 2014). Tea plant foliage is infested by about 167 arthropod species in the tea belt of Northeastern regions of India (Mukhopadhyay and Roy, 2009). The looper stage of the lepidopteran pest *Hyposidra talaca* have migrated and adapted in tea growing area of Darjeeling Terai and the Dooars and Assam causing substantial damage to the crop (Basumajumdar and Ghosh, 2004). Among them some arthropods are considered as pest and some are considered as biological control agents. In the tea ecosystem of Dooars and Darjeeling regions of West Bengal there are 29 species belonging to 28 genera of hemipteran bugs, among them the highest species is of family Pentatomidae have been recorded (Mitra *et al.,* 2018). In order to concise the application of synthetic chemical pesticides, in the tea gardens for the management of lepidopteran tea pests especially *H. talaca*, biological control measures are being adopted worldwide (Mobed *et al*., 1992 and Gillespie *et al*., 2000). *Eocanthecona furcellata* (Wolff) (Hemiptera: Pentatomidae) is one of the important predator that has recently included in the field of biological control due to its potential to prey different orders of insect pests such as, lepidoptera, coleoptera and heteroptera (De Clercq, 2000). This predacious stink bug *E. furcellata* (Wolff) is efficient lepidopteran caterpillar predators in the field of, soyabean, beans, vegetable and forest ecosystems found to feeding on fall army worm, *S. frugiperda* in maize (Navarajanpaul, 2002). In the present study, predatory behaviour and stage specific predation of this stink bug while feeding on larvae of *H. talaca* and biology and survival rate on alternative host were studied.

MATERIALS AND METHODS:

REARING OF HOSTS AND PREDATOR:

Field collected healthy moths of *H. talaca* were, put them into mating and egg laying chamber (glass chimney) with 10% honey solution as food source. After hatching of the eggs, larval stages were reared on tea leaves preferably using TV1 (Tocklai Vegetative 1) under the laboratory conditions (27± 2°C, 70-80% RH and 16:10 LD photoperiod) by following the methodology developed by Babu *et al.,* (2014). Eggs of rice meal moth of *Corcyra cephalonica* were collected from Uttar Banga Krishi Viswavidlaya, Coochbihar, India and reared on plastic container containing maize powder under the same laboratory conditions as an alternative host of *E. furcellata*. Adult stink bug were collected from the TRA (Tea Research Association) experimental plot and kept into glass chimney for mating and laying eggs containing few tea shoots along with larvae of *H. talaca*. Shade tree barks were kept inside the mating chamber for egg laying and the egg masses were transferred into separate chamber. Newly hatched first instar and then second instar nymphs of the predator were reared in group. Third, fourth, fifth and adult stages were put into separate Tarson sample container (Diameter 4.3, height 5.4cm) to avoid cannibalism following the method of Lenin and Rajan, (2016) with slight modifications.

PREDATORY BEHAVIOUR OF *E. FURCELLATA*:

In order to record the predatory behaviour of all the life stages of *E. furcellata* on the different larval instars of *H. talaca*, an experiment was conducted using large petridish (14.5cm in diameter). Each life stage of *E. furcellata* were maintained for 1.5h starved condition and then placed into that petridish with different larval instars of *H. talaca* separately. The time taken by the stink bug for approach attacking, paralyzing and sucking the prey by different life stages of were recorded (Rajan *et al.,* 2017). Mean were calculated by Tukey-Kramer HSD Post-Hoc Test.

STAGE SPECIFIC PREDATION:

Selection of specific stage of larvae of *H. talaca* and predation by different life stage *E. furcellata* were also studied under the same laboratory conditions. Different larval instars like, II, III, IV and V of *H. talaca* were provided to the individual stages of *E. furcellata*. The maximum number of prey consumption and type of feeding were observed at 24h interval.

STATISTICAL ANALYSIS:

Mean of the experiment of predatory behaviour was analyzed by Tukey's multiple comparison test at $p<0.05$.

REARING OF *E. FURCELLATA* ON ALTERNATIVE HOST:

From the laboratory rearing conditions 100 eggs were separately put into glass chimney and observed carefully till hatched. Newly hatched first instar nymphal instars were transferred into individual container and head crushed larvae of *C. cephalonica* were provided as food source from the laboratory stock culture. Every nymphal instars were carefully maintained till moulted into adult. Ten pairs of saults were separately put into glass chimney along with sufficient larvae of rice meal moth. After laying eggs onto the previously provided shade tree bark, it was collected and put into separate chimney. The incubation period, each nymphal duration for development, mortality and survival rate of each life stages were recorded at 24h intervals.

RESULTS AND DISCUSSIONS:

PREDATORY BEHAVIOUR OF *E. FURCELLATA*:

In the experiment of predatory behaviour of *E. furcellata*, larvae (II, III, IV and V instars) of *H. talaca* were provided as a visual stimulus which lead to arouse, erect posture and extension of antennae and rostrum towards the larvae. The time taken by different life stages of *E. furcellata* for approach and attacking, paralyzing and feeding were recorded during excited state. The result revealed that, first instar nymph of *E. furcellata* took 17.7±2.5seconds for approach attacking towards prey larva followed by II (16.7±0.6 seconds), III (15.3±2.1 seconds), IV (13.7±1.5 seconds) and V (11.7±1.5 seconds) instar. Nymph of I, II, III, IV, V instar, adult male and female of stink bug injected its venom and paralyzed the looper within 9.7±1.5, 8.7±1.5, 8.0±1.0, 7.7±1.5, 7.0±1.0, 5.0±1.0 and 4.7±0.6 seconds respectively. Kalaiyarasi *et al*., (2017) examined that, *E. furcellata* being excited directly approached towards *H. armigera* larvae on cotton plants. Yasuda (2000) reported that, when the lepidopteran larvae fed on the chlorophyll in their host plants, a chemical cue (E)- phytol is produced and most probably on that *E. furcellata* responded. He also reported that, *E. furcellata* prefers to predate on that larvae, which fed on a chlorophyll-rich diet. Once female of *E. furcellata* got excited, it pin the rostrum on the body of the fifth instar host larva, inject the venom and paralyzed within 4.7±0.6 seconds. Singh *et al*., (2019) observed that, after confirm capture of prey, *E. forcellata* wait for sometimes for paralyzation of silkworm and later on the predator again inserts its proboscis most frequently on the ventral side of the silkworm and suck the haemolymph. Then the host became paralyzed and was sucked the body sap by the female within95.3±5.0 seconds. The sucking period of other life stages of *E. furcellata* was more (Table 1).

Table 1: Predatory behaviour of *E. furcellata* feeding of different larval instars of *H. talaca*:

Predatory activities of *E. furcellata* (in second)						
Stages of *E. furcellata*	**Approach attacking**	**Paralyzing**	**Sucking (Larval stages of *H.talaca*)**			
			II	**III**	**IV**	**V**
I Instar	17.7±2.5^{a}	9.7±1.5^{a}	72.3±5.1^{a}	81.0±2.6^{a}		
II Instar	16.7±0.6^{ab}	8.7±1.5^{ab}	71.7±1.5^{a}	79.7±2.5^{a}		
III Instar	15.3±2.1^{ab}	8.0±1.0^{ab}	67.3±2.1^{ab}	77.0±3.6^{ab}	97.3±2.1^{a}	123.3±3.1^{a}
IV Instar	13.7±1.5^{bc}	7.7±1.5^{b}	65.3±4.0^{bc}	76.0±3.6^{abc}	94.0±3.6^{ab}	118.3±4.9ab
V Instar	11.7±1.5^{cd}	7.0±1.0^{b}	60.3±1.5^{cd}	74.7±4.2^{bc}	90.3±2.5^{abc}	113.7±3.5^{b}
Male	9.7±1.5^{de}	5.0±1.0^{c}	58.3±1.5^{d}	72.0±4.4^{abc}	87.3±5.9^{bc}	103.3±5.1^{c}
Female	8.0±2.0^{e}	4.7±0.6^{c}	56.0±2.6^{d}	71.7±3.2^{c}	84.7±4.5^{c}	95.3±5.0^{c}

Values represent mean ±SD of five replications. Means followed by the same letter in a column do not differ significantly at p=0.05, according to Tukey's multiple comparison test.

Male longevity	30.0±1.9
Female longevity	32.8±0.8
Fecundaty /female	284.6±11.8

STUDY ON BIOLOGY OF *E. FURCELLATA* ON *C. CHEPHA LONICA*:

In the present investigation, the biology of stink bug *E. furcellata* on the larvae *C. cephalonica* revealed that, adult female laid an average number of 284.6±11.8 eggs (Table 1). Incubation period was 7.6±1.1fed on *C. cephalonica*. Tuan *et al*., (2015) reported the fecundity of *E. furcellata* 829.16±66.3 when fed on *P. xylostella* and 725.66±53.5 *S. litura* which was higher than our findings. But the incubation period were 7.1±0.1 and 7.0±0.0 when reared on *P. xylostella* and *S. litura*, which is similar with our results. Siddaiah and Devi, (2015) observed the fecundity of *E. furcellata* developed on larvae of vapourer tussock moth and tasar silkworm were 302.54 ± 37.27 and 314.06 ± 25.20 respectively. Total nymphal period was completed within 18.4±1.5 days, wherein 3.2±0.4 and 4.0±0.7 days were taken by first and fifth instar nymph of this stink bug respectively. Our results are in the line of findings of Kalaiyarasi *et al*., (2017) and Siddaiah and Devi, (2015). Longevity of adult female 32.8±0.8 days and male 30.0±1.9 days reared on *C. cephalonica*. Our results are in well agreement with the study of Lenin and Rajan, (2016) who also reared on this predator on *C. cephalonica*. Siddaiah and Devi, (2015) also got similar trends of adult longevity. In the well maintained laboratory conditions successful life cycle of *E. furcellata* was noticed. There was 94.5% viable egg, 91.2% 1st instar, 92.3% 2nd instar, 93.4% 3rd instar, 95.6% 4th instar, 94.2% 5th instar and 96.2% adult survival of *E. furcellata* were recorded, maintained on *C. cephalonica* (Fig. 1). The observation of Lenin and Rajan (2016) showed 90% egg hatchability rate *E. furcellata* fed on larvae of *Corcyra cephalonica* which is little lower than our findings. Highest mortality was observed in case of first instar nyphal stage.

Table 2: Biology of *E. furcellata* on alternative host *C. cheph alonica*:

Mean duration of *E. furcellata* reared on	
Parameters	**Larvae of *C. cephalonica***
Incubation period	7.6±1.1
I instar	3.2±0.4
II instar	3.4±0.5
III instar	4.0±1.0
IV Vinstar	3.8±0.4
V instar	4.0±0.7
Total nymphal period	18.4±1.5
Pre-oviposition period	5.4±0.5
Oviposition period	18.0±1.6

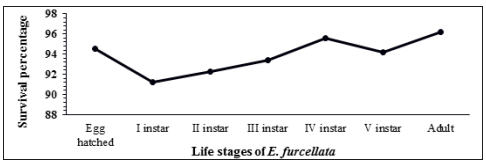

Fig. 1: Survival of different life stages of *E. furcellata* on *C. cephalonica*.

STAGE SPECIFIC PREDATION:

In order to fulfill the nutritional requirement of different life stage and availability of prey, larvae of *H. talaca* the stink bug *E. furcellata* select and feed on specific larval stage. In the table 4, data revealed that, t first and second instar nymph of stink bug mostly preferred to feed on second and third instar larva of *H. talaca* and shoed group feeding behaviour. It is may be the small body size of the predator. In the present study, third instar nymph of the predator preferred II, III and V instar prey larvae and showed individual feeding. Further, advanced instar nymph to the adult, all stages preferred big sized larvae of *H. talaca.* Similar predatory trends was described by Sarkar *et al*., (2019) who investigated on the predator *S. collaris* feeding on larvae of *H. talaca*.

Table 3: Stage specific prey selection of *E. furcellata* on larvae of *H. talaca*:

Stages of E. furcellata	Stage specificity	Type of feeding	Feeding preference
I	II & III instars	Group feeding	II Instar
II	II & III instars	Group feeding and starting of individual feeding	II instar
III	II, III & IV instars	Individual feeding	III & IV instars
IV	II, III, IV & V instars	Individual feeding	IV instar
V	II, III, IV & V instars	Individual feeding	IV & V instars
Male	II, III, IV & V instars	Individual feeding	IV &V instars
Female	II, III, IV & V instars	Individual feeding	IV &V instars

CONCLUSION:

The predatory behaviour of *E. furcellata* on the II, III, IV and V instar

larvae of *H. talaca* has reconfirmed that, it's paralyzing, sucking activity enhances the efficiency on predation. The mature stages of *E. furcellata* preferred big sized later instar of larvae more for their nutritional requirements. The biological fitness performance of *E. furcellata* fed on *C. cephalonica* confirmed that, larvae of rice meal moth could be used as an alternative host for the mass rearing under laboratory conditions. The outcome of this study may helpful to mass multiplication of stink bug in laboratory and release in field conditions for the improvement of IPM tools in order to manage *H. talaca* population in tea ecosystem.

ACKNOWLEDGEMENT:
We gratefully acknowledge the help rendered by Professor T. K. Hath, Uttar Banga Krishi Viswavidlaya, Coochbihar, India for providing the stack culture of eggs of *Corcyra cephalonica* for carrying out this research work.

REFERENCES:

1. Babu, A., Barua, A., Deb, S., Gogoi, B., Rahman, A. and Sarmah, M. 2014. Growth inhibitory effect of Ponneem, a botanical pesticide against the looper Ascotis selenaria Hubner infesting tea in northeast India. Two and a Bud, 61(1&2): 68-71.
2. Basu Majumdar, A. and Ghosh, P. 2004. Hyposidra talaca (Walker) a destructive pest of tea in Dooars tea plantations, Two and a Bud, 51: 49-51.
3. De Clercq, P. 2000. Predaceous stinkbugs (Pentatomidae: Asopinae). In: Heteroptera of conomic Importance. Boca Raton. Florida, CRC Press. 758-761.
4. Gillespie, D.R., Opit, G., Roitberg, B., 2000. Effects of temperature and relative humidity on development, reproduction and predation in Feltiella acarisuga (Vallot) (Diptera: Cecidomyiidae). Biological Control, 17: 132–138.
5. Kalaiyarasi, L. Livingstone, A. R. and Miracline, S. F. 2017. A Report on the Predatory Behaviour of Stink Bug Eocanthecona Furcellata Wolff (Hemiptera: Pentatomidae) on the Eggs and Grubs of Henosepilachna Vigintioctopunctata. International Journal of Recent Scientific Research, 8(8):19550-19554.
6. Lenin, E. A. and Rajan, S. J. 2016. Biology of predatory bug Eocanthecona furcellata Wolff (Hemiptera: Pentatomidae) on Corcyra cephalonica Stainton. Journal of Entomology and Zoology Studies, 4(3): 338-340.
7. Mitra, B., Shah, S. K. and Mishra, P. 2018. Insect Fauna associated with the Tea Ecosystem of North Bengal, India. Records of the zoological Survey of India. 118(2):178-193.
8. Mobed, K., Gold, E.B., Schenker, M.B. 1992. Occupational health problems among migrant and seasonal farm workers. Western Journal of Medicine, 157: 367-373.
9. Mukhopadhyay, A. and Roy, S. 2009. Changing dimensions of IPM in the tea plantations of the north eastern sub-Himalayan region. In: Proceedings of the National symposium on IPM strategies to combat emerging pests in the current scenario of climate change (Ramamurthy, V. V., Gupta, G. P. and Puri, S. N. eds.), Entomological Society of India, IARI, New Delhi, 290-302.
10. Navarajanpaul, A. V. 2002. Biological control of lepidopteran pests using important predators, Proceedings of the symposium on biological control of lepidopteran pests, Bangalore, pp. 19–28.
11. Rajan, S. J., Suneetha, N. and Sathish, R. 2017. Biology and predatory behaviour of an assassin bug, Sycanus collaris (Fabricius) on rice meal moth, Corcyra cephalonica (Stainton) and leaf armyworm, Spodoptera litura (Fabricius). Agriculture Update. 12(5): 1181-1186.
12. Sarkar, S., Babu, A., Chakraborty, K. and Deka B. 2019. Study on the Biology, Feeding Behaviour and predatory Potential of Sycanus collaris (Fabricius) (Heteroptera: Reduviidae), a new Predator of Hyposidra talaca (Walk.) (Lepidoptera: Geometridae), a major Tea pest and mass Rearing on Corcyra Cephalonica (Stainton) in Laboratory. International Journal of Current Advanced Research, 08(06):19258-19262.
13. Siddaiah, A. A., and Devi, A. R. 2015. Biology of a predatory bug Eocanthecona furcellata Wolff (Hemiptera: Pentatomidae) on Vapourer tussock moth larvae: a major pest of tasar silkworm food plants. International Journal of Industrial Entomology, 30(1) 26-30.
14. Singh, S., Jigyasu, D. K., Roy, D., Shabnam, A. A. and Das, R. 2019. Feeding Behaviour of Two Important Predator Bugs Eocanthecona furcellata Wolff and Sycanus collaris Fabricius in Muga Ecosystem. Research Journal of Agricultural Sciences, 10(1): 185-188.
15. Tuan, S. J., Yeh, C. C., Atlihan, R., and Chi, H. 2015. Linking Life Table and Predation Rate for Biological Control: A Comparative Study of Eocanthecona furcellata (Hemiptera: Pentatomidae) Fed on Spodoptera litura (Lepidoptera: Noctuidae) and Plutella xylostella (Lepidoptera: Plutellidae). Journal of Economic Entomology, 1–13: 1-12.
16. Yasuda, T. 2000. Role of semiochemicals in prey- locating behavior of a generalist predatory stink bug Eocanthecona furcellata (Heteroptera: Pentatomidae). Japan Agricultural Research Quarterly, 34:15-20.