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International Journal of Current Research
Vol. 6, Issue, 10, pp.9052--9056, October, 2014

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

BIOCONTROL POTENTIAL OF ENTOMOPHAGOUS PREDATOR *EOCANTHECONA FURCELLATA* (WOLFF) AGAINST *PERICALLIA RICINI* (FAB.) LARVAE

[1]*Nancy Shophiya, J. and [2]Sahayaraj, K.

[1]School of ENVITOX and Biotechnology, Loyola College, Chennai-600 034, India
[2]Crop Protection Research Centre, St.Xavier's College, Palayamkottai-627 002, India

ARTICLE INFO

Article History:
Received 26th July, 2014
Received in revised form
29th August, 2014
Accepted 18th September, 2014
Published online 25th October, 2014

Key words:

Pericallia ricini,
Eocantheona furcellata,
Biological control potential.

ABSTRACT

Laboratory experiments were conducted to find out the impact of the prey, *Periallia ricini* third instars stage and deprivation period on the feeding behavior and predatory rate of life stages was evaluated against an economically important lepidopteran pest, *P. ricini* (Lepidoptera: Arctiidae) under laboratory conditions. Third, fourth, fifth (nymphal instars) and adult (male and female) at 1st, 2ndand 3rd day under laboratory conditions. Results revealed that the third, fourth and fifth instars predator *Eocantheona furcellata* consumed 2.8, 5.8 and 7.3 preys and completed the stadia period in 3.9, 5.4 and 6.2 days and hence this predator could be used for the biological control agent of *P. ricini*. However, more studies are necessary to recommend this predator as a biological control agent.

INTRODUCTION

Eocanthecona furcellata (Wolff) (Hemiptera: Pentatomidae) distributed in India, (Chu and Chu, 1975a, 1975b), Southeast Asia, (De Clerq, 2000), the Southern part of China (Nyunt and Vidal, 2007), Taiwan and Okinawa (Yasuda, 2000). *Eocanthecona furcellata* is a generalist predators in limiting the impact of insect defoliators in eucalyptus forest eco-systems where several defoliator species can occur simultaneously (Zanuncio *et al*., 1994, Assis *et al*., 1998, lemos *et al*., 2001). In Taiwan it is used as a potential biological control agent to control pests in agricultural crops (Ho *et al*., 2003). *Prodenia litura* Fab. larvae of cotton (Ballard, 1923; Kapoor *et al*., 1973); slug caterpillar, *Latoia lepida* (Cramer) on mango (Ghorpade, 1972; Senrayan, 1988); leaf roller *Diaphania pulverulentalis* on mulberry (Annonymous, 1998; Rajadurai *et al*., 2000); *Semiothisa pervolgeta* Wlk, and *Terias hacabae* L. on Daincha (*Sesbania bispinosa*) (Cherian and Brahamchari, 1941); *Spilosoma oblique* on soybeen and sesame (Singh *et al*., 1989; Bhadauria *et al*., 1999) and pests of many other crops (Rai, 1978; Gope, 1981; Srivastava *et al*., 1987); *Zygograma bichtorata* (Pallister) (Pandey *et al*., 2005); *Clostera fulgurita* (Wlk) and *Milionia basalis* (Guentheri) (Hiroe Yasui, 2001) are the important preys of this predator. Ray (2008) studied the impact of prey depriviation on the predatory behavior and bioefficacy of this predator. No one has studied the biological control potential of *E. furcellata* against *P. ricini*. Keep this lacuna in our mind, we evaluated the biological control potential of this predator against *P. ricini* under laboratory condition.

Corresponding author: Nancy Shophiya, J.
School of ENVITOX and Biotechnology, Loyola College, Chennai-600 034, India.

Castor

Castor, *Ricinus communis* (Linn.) is one of the most important cash crop cultivated in dry lands as monocrop or mixed crop with grountnut, chilly, cotton and cowpea, etc… One of the major problems with agriculture now-a-days is the demand for the production of more and more, in order to provide food for the population which is in permanent augmentation. In realizing this, one of the stumbling blocks seems to be the yield losses due to pests (Dubey *et al.*, 2008). There are fourteen insect pest affects the castor plant. Insect pests are mainly controlled with synthetic insecticides over the last 50 years causing pesticide resistance and negative effects on non-target organisms, including humans, and also to the environment (Franzen, 1993). Hence alternative options like botanicals, natural enemies and microbial insecticides are subjected as well as practicing by farmers world-wide.

Pericallia ricini

Pericallia ricini Fab. (Lepidoptera: Arctiidae) commonly called as hairy caterpillar or wooly bear is the major pest of castor, gingelly, cotton, country bean, brinjal, drum stick, coccina, banana, calotropis, sunflower, oleander, tea, sweat potato, pumpkin (David and Ananthakrishnan, 2004; Atluri *et al.*, 2010) and vanilla (Vanitha *et al*., 2011), radish (Asafali *et al*., 1972), elephant foot, coccina, cow pea, yam, arum (Colocasia) (Nair, 1970; Butani and Jotwani, 1984; David, 2001). Various mechanical, chemical (Tasida and Gobena, 2013) and botanical (Joseph *et al*., 2010); mycoinsecticides (Sahayaraj and Borjio, 2012) pest control options have been used to control this pest. However, frequent misuse and abuse of chemical pesticides has led to the problems of pesticides resistance, resurgence and secondary out breaks of the pests besides several environmental hazards (Purwar and Sachan, 2006; Scholte *et al*., 2006; Jaramillo and Borgemeister, 2006). Use the natural compounds in the place of conventional can reduce environmental pollution, preserve non-target organisms and avert insecticide, induced pest resurgence. In past years, neem oil has been used against *P. ricini* (Mala and Muthalagi, 2008). Whole-plant extracts of the perennial common herb, *Datura stramonium* L. showed insecticidal and antifeedant properties against *P. ricini* (Prakash and Rao, 1997).

Natural enemies

Interest in the use of biopesticides with selectively against phytophagous insects has increased in recent years, particularly in cropping systems that rely on natural enemies as a major component of integrated pest management (Rausell *et al*., 2000). *Mikania micrantha* Kundh (Mini Abraham *et al*., 2002), *Vanilla planifolia* Andrews (vanitha *et al*., 2011). braconid wasp, Apanteles *taragamae* were considered as natural enemies of *P. ricini* (Raja *et al.,* 2000).

Objective

To observe the predatory potential of third, fourth, fifth and adult (both male and female) stages of *Eocanthecona furcellata* against *Pericallia ricini* larval stages.

Pest Collection and Rearing

Life stages of *P. ricini*, were collected from castor and cotton agroecosystems of Kottaiyur (N 9º 87’ 33.9’’, E 78º 66’ 98.7’’), Sivagangai District, Tamil Nadu, India. *Pericallia ricini* life stages were maintained on castor leaves at room temperature (29º±2ºC), relative humidity (70-80 %) and photoperiod of 11L and 13D Hrs in 1L capacity plastic containers (height 7.0 cm X diameter 15.0 cm). Laboratory emerged *P. ricini* adults (>1 day) separately were introduced into the oviposition chamber (height 43.7 cm X diameter 35.0 cm) and fed with 10% sucrose solution fortified with a few drops of vitamin mixture (Supradyn Multi vitamin tablet) to enhance the oviposition. The egg batches were removed and kept in Petri dishes (height 1.5 cm X diameter 9.5 cm) for hatching. Laboratory reared 6-12 hrs prestarved third, fourth and fifth instar larvae were used for the experiment.

Bioassay

Collection and maintenance of Predator

Various life stages of *Eocanthecona furcellata* were collected from *Acalypha indica* plant in and around St. Xavier’s College, Palayamkottai (08º 43’ 10’’ N; 77º 44’ 18’’ E). Collected predators were maintained under laboratory condition as mention above. Predator fed with *Pericallia ricini* third instar larvae. For stage preference and biological control potential evaluation experiments, third, fourth, fifth and adult predators were used.

Stage Preference

Stage preference was carried out on all life stages of *E. furcellata* (except first and second instar nymphs) against third, fourth and fifth instars of *P. ricini* larvae separately by a choice experiment as described by Holling (1959). One prestarved (<1 day) *E. furcellata* third instar nymph was introduced into a Petridish (height 1.5 cm x width 9.3 cm) and then two each of *P. ricini* third, fourth and fifth nymphs were released. Then the predatory behavior was observed consecutively for seven hours visually. Successfully captured and killed prey stage was considered as preferred life stage of E. furcellata. Ten replications with three insects each were maintained for each life stage separately. The preferred life stages of the pest were used for the biological control potential evaluation studies.

Biological control potential evaluation

Eocanthecona furcellata third, foruth, fifth nymphal instars and (adult males and females) were used for evaluating their biocontrol potential against preferred life stages of *P. ricini* three larvae were introduced into the Petri dish containing castor leaves and were allowed to acclimatize for 10 minutes. Then, one *E. furcellata* third instar nymph was introduced into the same Petri dish and closed with the lid. Feeding events such as capturing time, handling time, sites preferred by the predator for feeding were recorded continuously for seven hours. Similar procedure was followed to record the biological control potential of the predator during the second and third day using the same procedure as mentioned previously. During the experiment, every 24 hrs weight gained and number of prey consumed by a predator was recorded. Same procedure was adapted for the other stages of predator against their preferred stage preys. Ten replications were maintained for each life stage of the predator separately.

Nymphal development period

In another set of experiment, 30 first instars predators was introduced individually in plastic container (5 x 3 cm) and provided with two second instars *P. ricini* larvae for a day upto the completion of second instars. Then, the same predator was provided with preferred stages of *P. ricini* (three/day) up to the adult stages. During the experiment, number of prey consumed by a predator, stadia period for each stadium were recorded. Further, unfed and fed preys, moulted skin, dead predators were removed (if any) every day.

RESULTS AND DISCUSSION

The average incubation period of *Eocanthecona furcellata* fed with *P. ricini* was 7 days. Similar incubation period was recorded when provided with *Cnaphalocrocis medinalis* (Guenee) and *Ostrinia furnacalis* (Guenee) (Semillano and Corey, 1993), *Parasa philopide* and larval of *Acacia mearnsii* (De Wild) (Escalona and Abad, 1998).

Both first and second instars predator preferred to feed second instars larvae of *P. ricini*, complete their nymphal development with an average of 3.0 and 3.3 days respectively. Number of preys consumed was not recorded by us. The total nymphal developmental period was ranges from 22-25 days with a mean of 22.6 days. Previously it was reported that *E. furcellata* total nymphal developmental period was 21.55 days when provided with *Spilartica oblique* (Walk) (Kumar *et al*., 2006), 21.3 days fed on *Acacia mearnsii* 20.4 days fed on *Spodoptera litura*, 20 days when fed on lepidopteran larva (Semillano and Corey, 1993); 17 days for *Parasa philapida* (Escalona and Abad 1998). Since this predator has been recorded from many agroecosystems like maize (Boupha *et al*., 2006), cotton (Nyunt and Vidal, 2007) our results are very much useful to use this predator in IPM programme. In a separate set of experiments, we evaluated biological control potential (number of prey consumed as well as amount of food ingested per predator per day) against laboratory emerged predator against *P.ricini*.

Capturing time gradually diminished when the predator grew older. Within the same age also similar trend was observed except in the adult predator. In, third (df= 5,4; F=25.087; P<0.005) and fifth nymphal instars and adults (df= 9,2; F=257.550; P<0.017), capturing time was significantly high (df =5,4; F=14.08; P=0.068) during first day and second day of observation respectively.

However, significance was observed only in fourth instars (df=11, 1; F=9724.077; P<0.008) when comparison was made between first and second day. During the same period the predator consumed more number preys (df =1, 11; F=4.231; P<0.064). Among the life stages, third instars nymph consumed less number of preys (df=1, 8; F=6.000; P<0.040), whereas adults consumed more amount of food (df=3,6; F=3.574; P<0.086). Prey searching, identification, selection, capturing and feeding by a predator is depends on type, nature, size, agitity, texture of a prey. *Eocantecna furcellata* nymphs and adults selected their prey by visual stimuli, contact the prey by antenna, extended long ovoid like rostrum and rostral job over the prey, select a suitable site for feeding, relaxed the body by extending fore legs sidewise and without holding the prey suck and content (Plate 1a,1b). Very often change the sucking location and preferable select a location where no hairs distributed. Similar observations was also reported by Kumar *et al*. (2006) while a hairy caterpillar *Spilosoma oblique* offered to this predator.

During the third nymphal stage, first day consumed more amount of food and reduced by 49% and 53% during second and third day respectively. No difference was recorded between first and second day food consumption, however, third day predator consumed 10% more food by fourth instars. The third, fourth and fifth instars predator consumed 2.8, 5.8 and 7.3 preys and completed the stadial period in 3.9, 5.4, and 6.2 days respectively (Table 1, Figure 1,2).

Table 1. Predatory behavior of third nymphal instars of *Eocanthecona furcellata* against *Pericallia ricini* third instars larvae (Mean ± SE) (N=30)

Stages of Predator	Day(s) of	Capturing time (min)	Handling time (min)	Number of prey consumed	Amount of food consumed (mg)
Third	1	37.0 ± 0.9	86.1 ± 1.7	0.91 ± 0.2	37.5 ± 0.9
	2	30.8 ± 1.4	99.5 ± 2.4	0.72 ± 0.2	19.1 ± 0.5
	3	17.0 ± 0.6	65.9 ± 2.5	0.50 ± 0.1	17.0 ± 0.5
Fourth	1	25.3 ± 0.6	83.5 ± 1.0	0.92 ± 0.2	26.4 ± 0.7
	2	22.2 ± 0.6	86.1 ± 1.8	0.77 ± 0.2	26.1 ± 0.8
	3	20.5 ± 0.7	72.8 ± 1.1	0.81 ± 0.2	29.1 ± 0.7
Fifth	1	26.5 ±1.1	78.1 ± 1.5	0.77 ± 0.2	30.0 ± 1.0
	2	24.0 ± 0.6	84.0 ± 2.3	0.70 ± 0.1	20.0 ± 0.4
	3	43.9 ± 1.0	111.8 ± 2.0	0.90 ± 0.1	28.0 ± 0.4
Adult	1	7.1 ± 1.6	48.1 ± 0.7	0.87 ± 0.2	28.7 ± 0.8
	2	17.2 ± 0.7	30.0 ± 0.7	0.83 ± 0.2	30.8 ± 2.5
	3	14.9 ± 0.3	36.1 ± 0.8	0.79 ± 0.2	22.1 ± 0.6

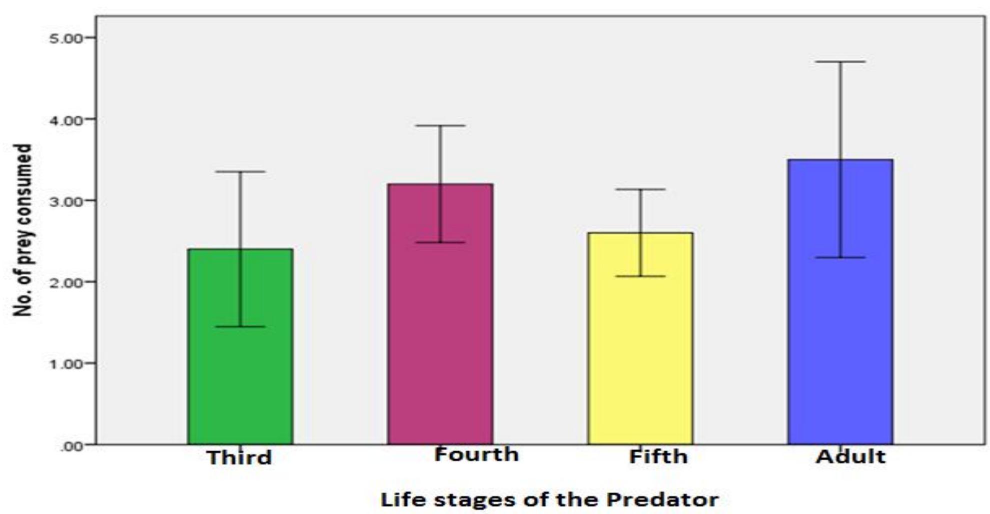

Figure 1. Total number of *Pericallia ricini* third instar larvae consumed by *Eocanthecona furcellata* third, fourth and fifth nymphal instars and adult (male and female) in laboratory condition

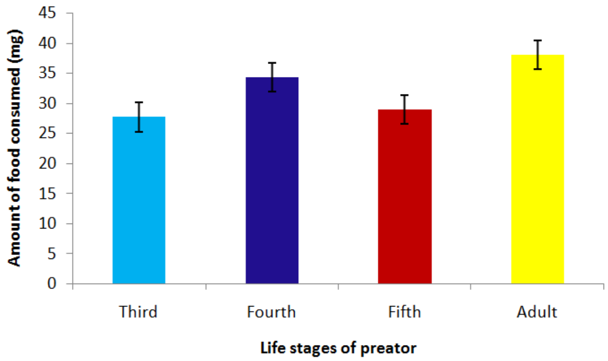

Figure 2. Total amount (mg) of *Pericallia ricini* third instars larvae consumed by *Eocanthecona furcellata* third, fourth and fifth nymphal instars and adult (male and female) in laboratory condition

(a)

(b)

Plate1. *Pericallia ricini* third (a) and fourth (b) instar nymphs consuming *Eocanthecona furcellata* third and fourth instars larvae respectively under laboratory condition

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