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Biology and Predation Efficiency of the Coccinellid Beetle *Propylea fallax* (Khuzorian) on Mungbean Aphid

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Abstract: The biology of *Propylea fallax* (Khuzorian) was studied in the laboratory using mungbean aphid as food. Mating period generally lasted upto 2 hours. A female laid 507.2 eggs on an average. The mean incubation period of the egg was 2.1 days with hatchability 98.87 percent. The larva completed four instars in 5.3 ± 0.19 days with almost similar duration of 1.5, 1.15, 1.05 and 1.6 days for 1st, 2nd, 3rd and 4th instar, respectively. The pre-pupal and pupal periods were 1.2 ± 0.13 and 2.0 ± 0 days. Adult longevity of male was 15.6 ± 0.57 days and 19.6 ± 0.66 days for the female. The average aphid consumption of the larva was 168.5 ± 7.18 and adult 806.6 ± 73.65. Both adult and larva preferred aphids having body width 0.25-0.75 mm, whereas above 1.0 mm were least preferred.

Key words: Biology, *P. fallax*, Predation efficiency, Prey sizes preference, Mungbean aphids

Introduction

The coccinellid species are distributed in many countries of Asia namely India, Bangladesh, Taiwan and Malaysia (Parker and Singh, 1973). They are of great economic importance as majority of them are predacious in their larval and adult stages on various crop pests such as aphids, coccids and other soft bodied insects (Rawat and Modi,1969).

A number of ladybird beetles have been listed as predator of aphids attacking different field crops and vegetables. *Propylea fallax* (Khuzorian) (Coleoptera: Coccinellidae) has been reported as a predator of aphid populations, coconut caterpillar, *Opsinia arenosella* (Wlk.) (Pillai and Nair, 1986). As biocontrol agent it is essential to have a through knowledge of its biology and predation efficiency. The biology of *P. fallax* has not been described elsewhere. The present work was undertaken to study the biology of the predator *P. fallax* as biocontrol agent on mungbean aphid *(Aphis craccivora* Koch).

Materials and Methods

Adult beetles were collected from the rice field and placed in pair (one male and one female) in several Petridishes (9 cm × 1.5 cm). Fresh shoots, inflorescens and pods of mungbean infested with aphids (*Aphis craccivora*) were placed in each petridish to ensure availability of food. After egg laying the beetles were transferred to another petridish. The date of egg laying and hatching period were recorded.

The young larvae immediately after hatching were isolated carefully and placed in separate petridishes with the help of soft brush. One larva was placed in a petridish. Ten replications were used for such experiments. Fresh mungbean aphids approximately 100 were supplied every morning to each larva. Data were taken carefully to record the time of moulting, number of instar and duration of each larval instar. Observation was made daily four times at 6:00 hours intervals. The larvae were kept undisturbed when feeding stopped and until the emergence of adults. The pre-pupal, pupal periods were also recorded. For observation preoviposition, oviposition period, fecundity and longevity, the adults were confined in a pair in a petridish by allowing them to mate there with supply of fresh aphids daily.

After hatched the 1st, 2nd , 3rd and 4th instars one larva was placed in a petridish and 40, 60, 80 and 100 aphids were supplied to different instars, respectively. After adult emergence, 120 aphids were supplied to an adult until its death. The number of aphids consumed by the larva and adult were counted daily.

Forty aphids consisting of four sizes viz. 0.25, 0.50, 0.75 and > 1.0 mm were placed (10 aphids of each sizes) in a petridish and a 1st instar larva was introduced. The number of aphids consumed by each larva was counted at 8 hours interval. The 2nd, 3rd, 4th instar larva and adult were also provided with 40 aphids of four different sizes in the same manner to determine the prey size preference at different life stages.

Results and Discussion

Mating: Mating of *P. fallax* took place 1 to 2 days after adult emergence. Mating was more frequent in the morning with maximum of 3 times observed in 24 hours. The beetle each male and female mated several times in its life. The mean mating duration was 2.08 ± 0.08 hours with the range from 1.45 to 2.30 hours.

Pre-oviposition Period: The pre-oviposition period ranged 3 to 4 days with mean of 3.3 ± 0.15 days (Table 1).

Oviposition Period: The oviposition period of the beetle ranged 17 to 22 days with mean period of 19.6 ± 0.66days (Table 1). During oviposition the female extended its pygidium and the eggs were deposited one after another. Female laid the maximum eggs during the first few days of its oviposition and thereafter the rate of egg laying decreased gradually. During egg deposition the female moves slowly.

Egg: The female did not show any preference for egg deposition. She laid eggs on the upper and lower surface of the leaves, shoots and top, bottom and side wall of the petridishes. The eggs were laid in clusters of 6 to 31 . The eggs remained attached vertically to the surface by means of

Table 1: Duration (days) and measurements 1 mm) of different life stages of *P. fallax*

Life stages	Mean duration (days) ± SE	Length (mm) ± SE	Breadth (mm) ± SE
Egg	-	1.15 ± 0.02	0.42 ± 0.01
Incubation period	2.10 ± 0.10	-	-
Larval period:			
First instar	1.50 ± 0.06	1.94 ± 0.01	0.65 ± 0.01
Second instar	1.15 ± 0.06	3.64 ± 0.06	1.07 ± 0.03
Third instar	1.05 ± 0.03	5.95 ± 0.02	1.70 ± 0.03
Final instar	1.60 ± 0.04	7.93 ± 0.02	2.25 ± 0.02
Pre-pupa	1.20 ± 0.13	-	-
Pupa	2.00 ± 00	4.15 ± 0.07	3.13 ± 0.06
Total larval period	5.30 ± 0.19	-	-
Pre-oviposition	3.30 ± 0.15	-	-
Oviposition	19.60 ± 0.66	-	-
Adult longevity:			
Male	15.60 ± 0.57	4.17 ± 0.02	3.17 ± 0.02
Female	19.60 ± 0.66	4.74 ± 0.06	3.57 ± 0.03

Table 2: Predation efficiency of different life stages of *P. fallax* on mungbean aphid under laboratory condition

Stages	Mean number of prey consumed ± SE
Larva:	
Instar-I	14.8 ± 1.02
Instar-II	29.4 ± 1.40
Instar-III	39.0 ± 1.41
Instar-IV	85.3 ± 3.35
Number of prey consumed in larval stages	168.50 ± 7.18
Adult:	
Male	597.0 ± 26.49
Female	1016.20 ± 41.75
Mean number of aphid consumed in its life span	806.60 ± 73.65

Table 3: Prey preference sizes (body width mm) of *P. fallax* on mungbean aphids

Stages	Prey sizes offered (mm)			
	0.25	0.50	0.75	>1.0 (Above)
Instar-I	4.0 b	3.50 b	1.75c	0 .0c
	(2.12)	(1.98)	(1.48)	(0.71)
	3.50b	6.00 a	5.25b	1.50b
	(2.00)	(2.55)	(2.40)	(1.40)
	3.50 b	6.75 a	6.25	2.75b
	(1.98)	(2.69)	(2.59)	(1.79)
	7.50 a	6.25 a	6.00b	5.25a
	(2.83)	(2.60)	(2.55)	(2.39)
	3.50 b	6.0 a	8.25a	6.75a
	(1.98)	(2.54)	(2.96)	2.66
$S\bar{x}$	0.12	0.11	0.10	0.14

sticky fluid. Most frequently females deposited eggs in masses or in rows, but in few occasions haphazardly. The mean daily fecundity of a female was 30.49 eggs and total number of eggs laid per female was 507.2 ± 28.29 and the fecundity ranged 476 to 609. The eggs were more or less oval shaped with slightly pointed ends. The colour of freshly laid eggs was yellow.

The viable eggs were transparent before hatching. Then the colour of the eggs changed gradually from transparent to white and ultimately crimson white just prior to hatching. Dark black head and legs of young larva were visible through egg membrane just before hatching. At this stage the larva exerted outward pressure by the head region with the help of legs at the end of micropyle which ruptured the egg chorion and ultimately young larva hached out. The mean length and breadth of an egg was 1.15 ± 0.02 mm and 0.42 ± 0.01 mm respectively (Table 1). The non-viable eggs began to shrink slowly after deposition and its size was reduced. Haphazardly laid eggs were observed to be non-viable. Out of 332 eggs, 327 eggs were hatched. The egg viability was 98.77 ± 0.7 percent. Islam and Nasiruddin (1978) observed in most cases 100 percent hatching of the eggs of *Micraspis discolor* (F.). The hatching percentage of *P. fallax* was quite high and similar to *M. discolor*.

Incubation period: The incubation period varies from 2 to 3 days with an average 2.1 ± 0.1 days (Table 1). Incubation period of other predators describe by many authors are similar to *P. fallax.* Islam and Nasiruddin (1978) reported that the incubation period of *M. discolor* was 2.0 days. The egg stage of *M. sexmaculatus* lasted for 2 to 3 days (Wangleelog and Thong, 1988).

Larva: The larva was soft bodied, black, elongated and somewhat flattened. The mandibles are distinct and sickle shaped. Three pairs of long, slender legs are located on the thorax. The larvae moulted thrice and passed four instars. The first instar larvae was dark black. The length and breadth of larva varied from 1.9 to 2.0 mm and 0.6 to 0.7 mm with mean 1.94 mm and 0.65 mm, respectively (Table 1). The duration of this instar ranged from 1.25 to 1.75 days with an average 1.5 ± 0.06 days (Table 1).

The second instar larva extruded by leaving their moults. The caste skin was visible in the petridish. The larva stopped feeding just before and after moulting, remains motionless for a little time. At this time the colour of larvae become whitish. At the second instar the larvae increases size, shape with distinct spot appears on dorsal side of the abdomen. The length and breadth of larva ranged from 3.5 to 4.0 mm and 1.0 to 1.2 mm with mean of 3.64 mm and 1.07 mm, respectively (Table 1). This instar lasted for 1.15 ± 0.06 days (Table 1).

Morphologically third and second instar larvae were similar but they differ in size and shape. Larvae in this instar became more active, feed more than previous instar and increases in size gradually. The length and breadth of larvae is 5.8 to 6.6 mm and 1.6 to 1.8 mm with average of 5.95 mm and 1.7 mm, respectively (Table 1). The duration of third instar lasted from 1.05 to 1.25 days with an average of 1.05 ± 0.03 days (Table 1).

In final instar, the body segments of the larva became more distinct. The larva increased in size and consumed more number of preys than other insect larvae. The thoracic and abdominal whitish spots turn brownish and the body of larva turned grayish. The larva measured from 7.9 to 8.0 mm with mean of 7.93 mm in length and 2.1 to 2.3 mm with mean of 2.25 mm in breadth (Table 1). The final instar lasted for 1.5 to 1.75 days with an average of 1.6 ± 0.04 days (Table 1). The total larval period ranged from 4.75 to 6.0 days with an average of 5.3 ± 0.19 days (Table 1).

Pre-pupa: At pre-pupal stage the fully mature larva shrinked to a short, thick and slightly bent or curved form. At the end of pre-pupal period the pygidium of larva fixed in a medium before going to pupation. The duration of pre-pupal stage ranged from 1 to 2 days with mean 1.2 ± 0.13 days (Table 1).

Pupa: At this stage the transformation of pre-pupa to pupa occured rapidly through split up of larval skin dorsally. The colour turned with presence of some sort of pigments and a total change of the larval characteristics viz. size, shape and colour. At later stage two blackish spots appear on the dorsal side of the body. It was noted that the male pupa was smaller

than female one. The mean length and breadth of pupa were 4.15 mm and 3.13 mm, respectively (Table 1). The pupal period lasted for 2.0 days (Table 1).

Adult: After completion of pupal stage, the adult emerged from the pupal skin. During emergence, the head came out first, then thorax and abdomen. The newly emerged adult remains inactive for a while. Freshly emerged adult is light orange in colour which gradually turns its original colour. No visible spot was found on the pronotum or elytra just after emergence.

The adult beetles were oval, convex shaped with bright orange to red orange elytra. The males are usually smaller than the females. In female, two blackish spots appeared on the dorsal side of the elytra at the early maturity stage; in male, whitish spots present behind the pronotum but the elytral spots became indistinct with the maturity. The female showed cannibalism when there occurred a food shortage. The mature beetle is brightly coloured. Average length and breadth of male was 4.17 mm and 3.17 mm and female was 4.74 mm and 3.57 mm (Table 1). The females live larger than male. The longevity of male and female was 14 to 18 days and 17 to 22 days with an average 15.60 ± 0.57 and 19.60 ± 0.66 days, respectively (Table 1).

Predation efficiency: The mean number of aphid consumed by the 1st instar larva was 14.8 ± 1.02 (Table 2). The feeding rate increased gradually with increased larval age. The 2nd, 3rd and 4th instar larva consumed 29.4 ± 1.40, 39 ± 1.41 and 85.3 ± 3.35 aphids (Table 2) individual, respectively. The mean number of aphid consumed by a larva in its total larval period was 168.5 ± 7.18.

After emergence, adult consumed few number of aphids. The feeding rate increased gradually with the maturity of adult and declined same manner. The total number of aphid consumed each male and female were 501 to 658 and 890 to 1109 with mean 597 ± 26.49 and 1016.2 ± 41.75, respectively. The mean number of aphid consumed by an individual in its different life stages was 806.6 ± 73.65. Ngammuang (1987) reported the predation efficiency of *M. discolor* in larval and adult stages were 21.8, 41.9, 66.25, 122.15 and 1295.7 aphids, respectively which is close proximity to *P. fallax.*

Prey size preference: Theist instar larva preferred of smaller size 0.25 mm (body width) aphids and consumed highest number of aphids (Table 3). The preferred were lowest to matured aphids >1.0 mm (body width). The 2nd, 3rd, 4th instar larva and adult preferred aphids having 0.5, 0.5, 0.25 and 0.75 mm sizes (body width), respectively.

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