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Biology and Feeding Potential of *Cheilomenes sexmaculata* Fabricius (Coleoptera: Coccinellidae) on Mustard Aphid

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Abstract: The biology and feeding potential of *Cheilomenes sexmaculata* Fabricius was studied in the laboratory at 27±2°C and 70±5% relative humidity on mustard aphid, *Lipaphis erysimi* Kaltenbach at National Research Centre on Rapeseed- Mustard, Bharatpur during 2006-07 in two sets of observations. The pooled mean fecundity was recorded as 294.80±18.79 eggs per female. The pooled mean ovipositional period, incubation period, larval period, pupal period, total developmental period (egg to adult) and adult longevity were recorded as 27.55±1.33, 2.68±0.12, 11.08± 0.21, 4.48±0.16, 18.24±0.49 and 92.25±1.61 days, respectively. The pooled mean feeding potential of grub and adult was 26.82±0.59 and 47.13±1.75 aphids per day per individual, respectively.

Key words: Biology, *Cheilomenes sexmaculata,* feeding potential, *Lipaphis erysimi,* mustard aphid.

Aphidophagous ladybird beetles are one of the most important groups of predators that are very frequently observed where aphids are abundant. *Cheilomenes sexmaculata* Fabricius synonym *Menochilus sexmaculatus* Fabricius (Coleoptera: Coccinellidae) is important aphidophagous predator that control aphid population to a great extent in nature (Reddy *et al.,* 2001). The mustard aphid, *Lipaphis erysimi* Kaltenbach (Homoptera: Aphididae) has been regarded as the key pest of rapeseed-mustard crops in almost all the parts of India (Bakhetia and Sekhon, 1989). Aphid infestation has been reported to cause seed yield losses from 26 to 96% (Phadke, 1980) and loss in oil content up to 15% (Verma and Singh, 1987). A large number of insecticides have been recommended for the management of this pest (Misra, 1993; Kumar *et al.,* 1996) of the country. These insecticides cause serious problems such as environmental pollution, insect resistance and pest resurgence besides adversely affecting beneficial organisms. Singh (2001) emphasized the use of predators for the management of aphids. Singh (1994) reported the biology and feeding potential of *Cheilomenes sexmaculata* on *Macrosiphum rosae.* There is a need to evolve eco-friendly strategy using the bio-agents for the management of mustard aphid and *C. sexmaculata* may be the potential predator. Keeping these aspects under consideration, the biology and feeding potential of *C. sexmaculata* on mustard aphid was studied under laboratory condition to find out its potential for the management of mustard aphid in rapeseed-mustard crops.

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Materials and Methods

Adults of *Cheilomenes sexmaculata* Fabricius were procured from Project Directorate of Biological Control, Bangalore, and reared on mustard aphid. The experiment was conducted in the laboratory at National Research Centre on Rapeseed-Mustard, Sewar, Bharatpur (Rajasthan) at 27±2°C and RH 70±5% in specimen jars (15 Lx15 Wx25 H in cm) covered with muslin cloth and fastened with rubber band. The mustard twigs infested with mustard aphid were supplied as food. The eggs were collected from the specimen jar and reared in other specimen jars till they became adults. The male and female were collected from this stock culture and kept separately in petri dishes (15 cm diameter) for mating. The studies on biology and feeding potential were conducted twice and termed 1st set and 2nd set to minimize the error. Twenty individuals were observed in each set as replication in all the developmental stages from egg to its mortality. The mated females individually were allowed to oviposit in separate petridishes (15 cm diameter) containing mustard aphid and observations on fecundity and ovipositional period were recorded. Twenty freshly laid eggs were kept individually in separate petridishes (15 cm diameter) on moistened filter paper. These filter papers were replaced daily to avoid contamination till hatching and the incubation period of the eggs was recorded. Soon after hatching, the grubs were provided with mustard aphid as food. Different stages of grubs were provided with sufficient number of aphids almost uniform size to avoid disparity in total biomass of food utilized. Each grub was provided daily with at least three times the number of aphid it had consumed on the previous day. The numbers of aphids left uncnsumed were counted next morning. The final instar grubs were provided with additional mustard leaves as a shelter for pupation. The emergence of adults were observed and the adults were observed from emergence to death to dermine longevity. The adult of *C. sexmaculata* was also provided daily with counted number of aphids and the daily consumption of adults on mustard aphid was recorded till their death to find out their feeding potential. Observations were also recorded on the duration of different instars and their feeding potential, pupal period and adult longevity.

Results and Discussion

Biology

Egg: The freshly laid eggs were small, cigar shaped and shiny deep yellow in color and turned light gray just before hatching. The average incubation period was 2.85± 0.20 days in 1st set of observation and as 2.50±0.11 days 2nd set of observation and the pooled mean was found as 2.68±0.12 days. Bhadauria *et al.* (2001) reported the incubation period of *C. sexmaculata* as 2.5 days on mustard aphid that support present observations.

Grub: The average duration of first, second, third and fourth grub instars were recorded as 2.45±0.11, 2.25±0.10, 2.60±0.11 and 3.55±0.15 days, respectively, in 1st set of observation and the total grub period was recorded as 10.85±0.32 days. In 2nd set of observation, the average duration of first, second, third and fourth grub instars were found as 2.55±0.11, 2.15±0.08, 2.75±

Table 1. Biology of Cheilomenes sexmaculata on mustard aphid

Developmental stages	1st set	2nd set	Pooled mean
	Mean±SEm (Range)		
Fecundity (No. of eggs/female)	271.85±24.84 (145-422)	317.75±24.97 (180-475)	294.80±18.79 (162.5-458.5)
Ovipositional period in days	25.45±1.86 (15-38)	29.65±1.01 (22-35)	27.55±1.33 (18.5-36.5)
Incubation period in days	2.85±0.20 (2-4)	2.50±0.11 (2-3)	2.68±0.12 (2.0-3.5)
1st Instar period in days	2.45±0.11 (2-3)	2.55±0.11 (2-3)	2.50±0.11 (2-3)
2nd Instar period in days	2.25±0.10 (2-3)	2.15±0.08 (2-3)	2.20±0.09 (2-3)
3rd Instar period in days	2.60±0.11 (2-3)	2.75±0.10 (2-3)	2.68±0.11 (2-3)
4th Instar period in days	3.55±0.15 (2-4)	3.85±0.08 (3-4)	3.70±0.12 (2.5-4.0)
Total larval period in days	10.85±0.32 (8-13)	11.30±0.21 (9-13)	11.08±0.21 (8.5-13.0)
Pupal period in days	4.75±0.22 (4-6)	4.20±0.20 (3-5)	4.48±0.16 (3.5-5.5)
Total developmental period (egg to adult) in days	18.45±0.74 (14-23)	18.00±0.52 (14-21)	18.24±0.49 (14-22)
Adult longevity in days	88.95±1.52 (80-100)	95.55±2.49 (85-115)	92.25±1.61 (82.5-107.5)

0.10 and 3.85±0.08 days, respectively, and the total grub period was recorded as 11.30± 0.21 days. Pooled mean of first, second, third and fourth grub instars period were found as 2.50±0.11, 2.20±0.09, 2.68±0.11 and 3.70±0.12 days, respectively, with pooled mean of the total grub period was as 11.08±0.21 days. Present results are in line with the observations of Singh (1994) and Bhadauria *et al.* (2001) who reported 10.83 days and 11.8 days grub period of *C. sexmaculata* on mustard aphid, respectively.

Pupa: The average pupal period was recorded as 4.75±0.22 days in 1st set and 4.20±0.20 days in 2nd set and the pooled mean was found as 4.48±0.16 days. Bhadauria *et al.* (2001) reported the pupal period of *Menochilus sexmaculatus* as 5.5 days on mustard aphid, however, Reddy *et al.* (2001) reported the pupal period of C. *sexmaculata* as 3.60 days on *Macrosiphum rosae* that supported the present study with minor variation.

Adult: The adult female laid a total of 145 to 442 eggs with an average of 271.85± 24.84 eggs during its ovipositional period of 25.45±1.86 days in 1st set of observation, 180 to 475 eggs with an average of 317.75± 24.97 eggs during its ovipositional period

Table 2. Feeding potential of Cheilomenes sexmaculata on mustard aphid

Developmental stages	1st set		2nd set		Pooled mean	
	Mean±Sem (Range)		Mean±Sem (Range)		Mean±SEm (Range)	
	Per day consumption	Total consumption	Per day consumption	Total consumption	Per day consumption	Total consumption
1st Instar	9.85±0.54 (7-15)	24.50±2.08 (14-45)	9.50±0.54 (5-12)	23.95±1.58 (10-36)	9.68±0.54 (6.0-13.5)	24.23±1.83 (12.0-40.5)
2nd Instar	21.35±0.91 (15-27)	48.45±3.32 (30-81)	19.25±1.12 (12-25)	41.60±3.21 (24-75)	20.3±1.02 (13.5-26.0)	45.03±3.27 (27-78)
3rd Instar	33.40±1.12 (23-38)	88.05±5.55 (46-114)	28.85±0.98 (20-33)	79.95±4.35 (40-99)	31.13±1.05 (21.5-35.5)	84.00±4.95 (43.0-106.5)
4th Instar	49.10±1.83 (36-59)	177.0±11.55 (72-236)	43.25±1.46 (32-51)	167.60±7.64 (96-204)	46.18±1.65 (34-55)	172.3±9.60 (84-220)
No. of aphids consumed during grub period	113.70±2.56 (81-139)	338.00±15.90 (162-476)	100.85±2.49 (69-121)	313.10±11.91 (170-414)	107.28±2.34 (75-130)	325.55±12.25 (166-445)
No. of aphids consumed/ day/grub	28.43±0.64 (20.3-34.8)	–	25.21±0.62 (17.3-30.3)	–	26.82±0.59 (18.8-32.5)	–
No. of aphids consumed/ day/adult	50.15±2.23 (39-69)	–	44.10±2.42 (35-70)	–	47.13±1.75 (37.0-69.5)	–

of 29.65±1.01 days in 2nd set of observation. The pooled mean of fecundity was found as 294.80±18.79 eggs during the mean ovipositional period of 27.55±1.33 days. Saha (1987) reported higher fecundity of *Menochilus sexmaculatus* on *Aphis gossypii* from 1068 to 1391 eggs and Tank and Korat (2007) also found higher fecundity which ranged from 195 to 839 eggs with cotton aphid, *Aphis gossypii,* while Bhadauria *et al.* (2001) reported 277 eggs on mustard aphid. All these results support the present findings.

Longevity: The average longevity of adults was found 88.95±1.52 days in 1st set of observation, 95.55±2.49 days in 2nd set of observation and pooled mean longevity was found as 92.25±1.61 days. Bhadauria *et al.* (2001) and Reddy *et al.* (2001) reported the adult longevity of 45 days and 41.51 days, respectively. However Saha (1987) reported the adult longevity of *Menochilus sexmaculatus* on *Aphis gossypii* from 80 to 112 days that supports the present investigation. The life cycle from egg to adult was completed in 18.45± 0.74 days in 1st set of observation, 18.00±0.52 days in 2nd set of observation and pooled mean was 18.24±0.49 days Bhadauria *et al.* (2001) reported the total

duration of life cycle of *Menochilus sexmaculatus* on *Lipaphis erysimi* as 19.8 days, however, Debaraj *et al.* (1997) reported the total duration of life cycle of *M sexmaculatus* on *Myzus persicae* as 21.23 days, respectively, that is in corroboration to the present study.

Feeding Potential

Table 2 revealed that the mean daily consumption of first, second, third and fourth grub instars of *C. sexmaculata* was found to be 9.85±0.54, 21.35±0.91, 33.40± 1.12 and 49.10±1.83 aphids, respectively, in 1st set of observation, however, grub consumed 28.43±0.64 aphids per day and total consumption by a single grub was 338.00±15.90 aphids. In 2nd set of observation, the mean daily consumption of first, second, third and fourth instars grub was found as 9.50±0.54, 19.25±1.12, 28.85±0.98 and 43.25±1.46 aphids, respectively, while the mean daily consumption was 25.21±0.62 aphids per grub and the mean total consumption by a grub was 313.10±11.91 aphids. Pooled mean daily consumption of first, second, third and fourth grub instars was as 9.68±0.54, 20.3±1.02, 31.13±1.05 and 46.18±1.65 aphids, respectively. Pooled mean consumption by the single grub of *C. sexmaculata* was 26.82±0.59 aphids per day and total consumption in grub period was 325.55±12.25 aphids. Bhadauria *et al.* (2001) reported per day consumption by grub as 28.0 individuals of *Lipaphis erysimi,* Sharma *et al.* (1997) as 35.4 individuals of *Lipaphis erysimi* and Reddy *et al.* (2001) as 29.8 individuals of *Macrosiphum rosae* that are in corroboration with our study. Adult of *C. sexmaculata* consumed 50.15±2.23 aphids per day in 1st set of observation and 44.10±2.42 aphids per day in 2nd set of observation and pooled mean of 47.13±1.75 aphids per day. Bhadauria *et al.* (2001) reported per day consumption by adult *C. sexmaculata* as 28.0 individuals of *Lipaphis erysimi,* Sharma *et al.* (1997) 22.5 to 49.3 individuals of *Lipaphis erysimi* and Reddy *et al.* (2001) 50.4 individuals of *Macrosiphum rosae* that support present findings. It is inferred that *C. sexmaculata* had the long life span and high predatory potential against the mustard aphid and may be suitable for proper utilization in bio-control based integrated pest management.

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