

Original Research Article

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Predatory Potential of Spotted Ladybird Beetle, *Harmonia octomaculata* (Fabricius) (Coccinellidae: Coleoptera) on Lucerne aphid, *Acyrtosiphon pisum* (Harris) (Aphididae: Hemiptera) under Laboratory Conditions

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ABSTRACT

Keywords

Feeding potential, spotted ladybird beetle, *Harmonia octomaculata* (Fabricius), Lucerne aphid, *Acyrtosiphon pisum* (Harris)

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Studies on predatory potential of larva and adult of *H. octomaculata* on *A. pisum* was carried out under laboratory conditions during January 2018 to April 2018. The results showed that the first, second, third and fourth instar larva consumed an average of 15.72 ± 2.66 , 25.72 ± 4.79 , 53.58 ± 10.93 and 88.94 ± 14.79 aphids, respectively. The total larval consumption was 183.96 ± 17.97 aphids during its total developmental period when reared on *A. pisum*. The mean daily consumption of first, second, third and fourth instar larva was 12.09 ± 3.03 , 14.11 ± 3.36 , 21.61 ± 5.60 and 25.38 ± 4.88 aphids, respectively. The consumption of male and female adults of *H. octomaculata* was 1464.24 ± 76.40 and 1584.58 ± 80.92 aphids, respectively. Per day consumption of male and female adults was 53.86 ± 3.56 and 57.77 ± 6.59 aphids, respectively. The total consumption of *H. octomaculata* during entire lifespan was 1708.37 ± 58.63 aphids when fed on *A. pisum*.

Introduction

Coccinellid beetles are important predators of aphids in agricultural crops and have been used as biological control agents against a number of aphid species due to their ability to feed on a wide range of prey and these predatory beetles are voracious in nature and have a rapid numeric response thereby they have wonderful potential for utilization in biological pest control programme of aphids in various agro-ecosystem (Shinde, 2012).

Among the various cultivated crops, lucerne, *Medicago sativa* L. (Family: Medicago) has the highest feeding value as a commonly grown fodder crop. The aphids such as pea aphid, *Acyrtosiphon pisum* (Harris), blue-green aphid, *Acyrtosiphon kondoi* (Shinjii) and spotted alfalfa aphid, *Therioaphis trifolii* (Fab.) are severely feeding on lucerne crop and resulted in to 25 per cent of global production losses. The lucerne aphid, *A. pisum* is large in size compared to other aphids and green in colour with long appendages, usually

abundant from spring to early summer and autumn (Ryalls *et al.*, 2013). The aphid infestation reduces the quality and quantity of lucerne crop. This crop harbour different natural enemies *viz.*, coccinellids, syrphids, chrysopids and hemipterous predators as well as hymenopterous parasitoids. Among the predator species of lucerne crop, coccinellids showed maximum preference (47-62%) on aphids while it was 5 to 13 per cent by dipterans (Parihar and Vir, 1991). Therefore, sucking pest could be managed by incorporating the predator to sustain crop yield. The studies on the predatory potential of *H. octomaculata* on Lucerne aphid *A. pisum* would help in augmentation of this native and potent predator in the management of aphids.

Materials and Methods

The studies were conducted at PG Research Laboratory, Department of Agricultural Entomology, N.M.C.A., N.A.U., Navsari (Gujarat) at $30.41 \pm 3.18^{\circ}\text{C}$ temperature and 42.80 ± 7.64 per cent relative humidity during January 2018 to April 2018. Predatory beetles and lucerne aphids were collected from lucerne field of Forage Research Scheme, NAU, Navsari and maintained under laboratory condition. Fifty neonate larvae were reared separately in plastic vials (6 x 4 cm) by providing the lucerne aphids right from the hatching to pupation. Each larval instar was provided with a counted number of aphids (nymphs and adults) to know the feeding potential. The numbers of aphids were increased as the larva entered into next instar. The number of aphids consumed by the larva in 24 hrs was obtained by subtracting the number of aphids leftover from the total number of aphids supplied. Thus, the larval feeding potential was worked out for each instar as well as for the entire larval period.

To study the adult feeding potential, newly emerged adults of *H. octomaculata* beetles

were kept separately in plastic containers (6 x 4 cm). A set of fifty adults was provided with a counted number of aphids. Numbers of aphids consumed during 24 hrs was obtained by subtracting the number of aphid left over from the total number of aphid supplied. The fresh new aphids were reintroduced daily during the present investigation. Thus, the feeding potential of an adult was worked out.

Results and Discussion

Larva

The grubs of *H. octomaculata* were voracious feeder and found highly active during predation.

Feeding potential by first instar larva

Freshly hatched larvae fed on the egg shell in the absence of aphids while neonate first instar larva after emergence moved in search of prey. The larva showed chewing action and consumed abdominal portion of prey by leaving the sclerotized head and legs (Plate-I(A)). Sometimes cannibalism was observed in laboratory reared culture during food scarcity.

The data presented in Table-1 indicated that the predatory capacity of *H. octomaculata* during first instar varied from 10 to 19 aphids with an average of 15.72 ± 2.66 aphids. The per day consumption *H. octomaculata* on *A. pisum* by predatory first instar larva of *H. octomaculata* was 9 to 18 aphids (Av. 12.09 ± 3.03 aphids). The present findings on predatory potential of first instar larvae of *H. octomaculata* are partially agreed with the report of Rajan *et al.*, (2018) who revealed that the first instar of *Coccinella transversalis* (Fabricious) consumed total 10 to 18 cabbage aphid, *Brevicoryne brassicae* (Linnaeus) aphids with an average of 15.20 ± 2.60 aphids and daily consumption was 4 to 6 aphids with an average of 5.30 ± 0.67 aphids. Patel *et al.*,

(2018) revealed that the first instar of *Propylea sp.* consumed 4 to 13 (Av. 10.16 ± 1.93) *A. pisum* aphids. The difference in feeding potential of first instar might be due to the influence of different host insect and predators used in this experiment, adopted methodology and prevailing weather condition.

Feeding potential by second instar larva

Second instars larvae were more efficient feeder than first instar. They attack any part of the aphids but regularly fed on soft portion of abdomen. The grub holds prey rapidly by using forelegs held in a position to avoid the prey to escape and consumed whole aphids with chewing action (Plate-I(B)). More or less similar observations were made by Rajan *et al.*, (2018). First instar cannibalism by second instar was observed in laboratory culture when scarcity of prey and when all stages were kept together in group rearing under laboratory conditions.

The data presented in Table-1 indicated that the predatory capacity of *H. octomaculata* during second instar varied from 20 to 39 aphids with an average of 25.72 ± 4.79 aphids. The per day consumption on *A. pisum* by predatory second instar larva was 10 to 22 (Av. 14.11 ± 3.36 aphids). The present results are slightly deviated from the findings of Rajan *et al.*, (2018) who noticed that second instar of *C. transversalis* consumed total 36 to 48 aphids when fed on cabbage aphids, *B. brassicae* with average of 39.50 ± 3.81 aphids and daily consumption was 11 to 13 aphids with average of 12.40 ± 0.70 aphids. Patel *et al.*, (2018) revealed that the predatory potential of *Propylea sp.* second instar was 16 to 21 (Av. 26.66 ± 7.59) *A. pisum* aphids. The difference in the feeding potential of *H. octomaculata* with past worker might be due to the influence of different host insect, adopted methodology and weather conditions.

Feeding potential by third instar larva

Third instar consumed more aphids than second instar. Mode of feeding action and cannibalism behavior was similar as second instar (Plate-I(C)).

The data presented in Table-1 indicated that the predatory potential of *H. octomaculata* during third instar varied from 37 to 81 aphids with an average of 53.58 ± 10.93 aphids. The per day consumption on *A. pisum* by predatory third instar larva was 14 to 33 aphids (Av. 21.61 ± 5.60 aphids). The present findings are deviated from the results of Rajan *et al.*, (2018) who reported that third instar of *C. transversalis* consumed 60 to 100 cabbage aphids, *B. brassicae* with average of 86.30 ± 13.71 aphids and daily consumption was 20 to 25 aphids with average of 23.30 ± 1.89 aphids. Patel *et al.*, (2018) revealed that the feeding potential of *Propylea sp.* third instar was 26 to 71 (Av. 52.86 ± 12.87) aphids (*A. pisum*). The difference in the feeding potential of third instar larva of *H. octomaculata* might be due to influence of host insect, adopted methodology and prevailing weather condition.

Feeding potential by fourth instar larva

The fourth instars were found more voracious in nature. The feeding behavior was similar as third instar while severe cannibalism was observed by fourth instar larvae during scarcity of prey in laboratory reared culture (Plate-I(D)).

The data presented in Table-1 indicated that the predatory capacity of *H. octomaculata* during fourth instar varied from 69 to 139 aphids with an average of 88.94 ± 14.79 aphids. The per day consumption on *A. pisum* by predatory fourth instar larva was 17.25 to 37.67 aphids (Av. 25.38 ± 4.88 aphids). The present findings are deviated from the results

of Ali *et al.*, (2017) reported that the aphids consumption by fourth larval instar *Coccinella septempunctata* (Lin.) was 315.00 *Aphis gossypii* (Glover) aphids. Rajan *et al.*, (2018) who revealed that fourth instar larva of *C. transversalis* consumed 152-185 cabbage aphid (*B. brassicae*) with an average of 167.30 ± 12.35 aphids with daily consumption was 36 to 40 aphids with average of 38.20 ± 1.81 aphids. Patel *et al.*, (2018) revealed that the fourth instars of *Propylea sp.* consumed 62 to 83 (Av. 75.06 ± 4.32) *A. pisum* aphids. The report of Patel *et al.*, (2018) supports the present findings.

Total larval feeding potential

The data presented in Table-1 showed that the feeding rate increased gradually from the first to fourth instar. The predatory capacity of *H. octomaculata* during entire larval duration was varied from 157 to 229 aphids with an average of 183.96 ± 17.97 aphids. The per day consumption on *A. pisum* by predatory larva was 54.00 to 86.75 aphids (Av. 73.19 ± 7.75 aphids). Further, Rauf *et al.*, (2013) revealed that the larvae of *C. septempunctata* consumed 667.8 *Schizaphus graminum* (Rond.) aphids at $30 \pm 1^\circ\text{C}$ temperature. Rajan *et al.*, (2018) revealed that the fourth instar of *C. transversalis* consumed 268 to 329 aphids with average of 308.30 ± 32.48 aphids during its larval period. Khan *et al.*, (2016) reported that the larva of *Harmonia dimidiata* (Fab.) consumed 827.7 ± 13.39 *M. persicae* aphids during larval duration under laboratory condition. The present findings are deviated from the above worker and it might be due to different coccinellid predator and prey species used in this experiment, adopted methodology and prevailing weather condition.

Feeding potential by adult

The feeding behavior of grub and adults were more or less similar. Adult attacked any body

part of aphid and showed a chewing action and the whole prey was consumed (Plate-I(E)). The prey consumption of female adult was observed more than male adult during the present investigation and it might be due to requirement of food material to perform the adult maturity and reproduction activity. Egg cannibalism by adult was observed during food scarcity in laboratory reared culture.

The results obtained during the present investigation are presented in Table-1 revealed that male beetle consumed 1231 to 1539 aphids (Av. 1464.24 ± 76.40 aphids) during adult period while, female beetle consumed 1332 to 1699 aphids (Av. 1584.58 ± 80.92 aphids). The overall data indicated that female adults lived longer and consumed more number of aphids than male adults of *H. octomaculata*. The present investigation on feeding potential of adults are deviated from the results of Khan *et al.*, (2016) who revealed that the predatory potential of male and female of *H. dimidiata* was maximum 14183.0 ± 543.76 and 15375.0 ± 549.98 aphids at $24 \pm 1^\circ\text{C}$ when fed on *M. persicae*. According to Mishra and Kanwat (2017), the female adult of *C. septempunctata* consumed 1899.95 aphids while, male adult consumed 1508.28 aphids during its life time when fed on *L. erysimi*. Guroo *et al.*, (2017) reported that the male and female of *C. septempunctata* consumed 1172.8 ± 14.99 and 1515.3 ± 20.56 aphids, respectively when fed on *L. erysimi*.

Data pertaining to per day consumption ability of *H. octomaculata* is presented in Table-1 indicated that the male beetle consumed 44.89 to 59.84 (Av. 53.86 ± 3.56) aphids while female beetle consumed 45.94 to 69.04 (Av. 57.77 ± 6.59) aphids when fed on *A. pisum*. The present findings are disagree with the report of Mishra and Kanwat (2017) who reported that the daily feeding potential of female and male of *C. septempunctata* on *L. erysimi* was 158.32 ± 1.03 and 125.69 ± 3.26

aphids, respectively. The deviation in the feeding potential of adult of *H. octomaculata* might be due to difference in the predator and

prey species used in present study and weather condition existing in a particular locality.

Table.1 Feeding potential of larva and adult of *H. octomaculata* on Lucerne aphid, *A. pisum*

Stages	No. observed	Total aphids consumed			Per day aphids consumption		
		Min.	Max.	Av. ± S.D.	Min.	Max.	Av. ± S.D.
Larva							
I instar	50	10	19	15.72 ± 2.66	9	18	12.09 ± 3.03
II instar	50	20	39	25.72 ± 4.79	10	22	14.11 ± 3.36
III instar	50	37	81	53.58 ± 10.93	14	33	21.61 ± 5.60
IV instar	50	69	139	88.94 ± 14.79	17.25	37.67	25.38 ± 4.88
Total consumption	200	157	229	183.96 ± 17.97	54.00	86.75	73.19 ± 7.75
Adult							
Male	50	1231	1539	1464.24 ± 76.40	44.89	59.84	53.86 ± 3.56
Female	50	1332	1699	1584.58 ± 80.92	45.94	69.04	57.77 ± 6.59
Total consumption during entire lifespan	300	1499.0	1791.5	1708.37 ± 58.63	-	-	-



A- First instar



B- Second instar



C- Third instar



D- Fourth instar



E- Adult

Plate-I: Predation of different larval stages and adult of *H. octomaculata* on *A. pisum*

Total feeding potential during entire life span

The total feeding potential of *H. octomaculata* on *A. pisum* during whole lifespan is presented in Table-1 and the result noted that the consumption ability varied from 1499.0 to 1791.5 aphids with an average of 1708.37 ± 58.63 aphids. Earlier, Manpoog *et al.*, (2016) who reported that the adult of *C. septempunctata* consumed 2691.00 ± 533 aphids (*L. erysimi*) during its total lifespan and daily consumption was 81.55 ± 15.34 aphids; 2429.83 ± 262.28 aphids were consumed by the adult of *C. septempunctata* when reared on *L. erysimi* (Yadav *et al.*, 2016). The above findings are deviated from the present investigation and it might be due to change in predator and prey species, adopted methodology and prevailing weather conditions.

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