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Predatory potential of zig zag ladybird beetle, *Cheilomenes sexmaculata* (Fabricius) (Coccinellidae: Coleoptera) on cowpea aphid, *Aphis craccivora* (Koch) (Aphididae: Hemiptera)

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Abstract
Studies on predatory potential of larva and adult of *C. Sexmaculata* on *A. craccivora* was carried out under laboratory conditions during January 2022 to March 2022 at Navsari Agricultural University, Navsari. The mean per day consumption of the first, second, third and fourth instar was 8.42±1.86, 10.21±3.34, 16.13±2.47 and 36.32±3.78 aphids, respectively. The mean total consumption of first, second, third and fourth instar was 10.78±2.71, 22.48±4.40, 36.78±6.93 and 119.12±18.18 aphids, respectively. The total larval consumption was 189.16±25.28 aphids during its developmental period when reared on *A. craccivora*. The mean per day consumption in female adults of *C. sexmaculata* was 35.54±11.66 aphids while in males it was 32.67±10.92 aphids. The mean total consumption in female and male adults was 760.62±49.33 aphids and 555.4±41.63 aphids, respectively.

Keywords: *Cheilomenes sexmaculata*, *Aphis craccivora*, predatory potential, coccinellid, aphid

1. Introduction
Biological control is a key ecosystem service and underlying pillar of Integrated Pest Management (Bale *et al*., 2008; Naranjo *et al*., 2015) [1, 5]. Biological control of insect pests signifies the use predators, parasitoids, and pathogens (Smith, 1919) [14]. Coccinellids are the major group of predatory insects feeding on many agricultural pests (Omkar and Pervez, 2000) [6]. Both the larval and adult stages are predaceous in nature. They have been used for successful biological control of many agricultural pests (Pervez and Harsur, 2020) [8]. The zigzag ladybird, *Cheilomenes sexmaculata* (Fabricius) is the predominant ladybird beetle with wide distribution in South Western Asia, Indonesia, Philippines, South Africa, Pakistan and India (Routray *et al*., 2016) [10]. The important features of *C. sexmaculata* includes its diverse habitats, wide host range, tolerance to certain pesticides, good searching ability, voracious larval and adult feeding capacity and easy rearing in laboratory (Shanmugapriya *et al*., 2017) [11]. However, the development and feeding potential of coccinellids varies with their food and changes with the environmental conditions. Therefore, the study was undertaken to determine the feeding potential of *C. sexmaculata* on the cowpea aphid, *Aphis craccivora* (Koch) under South Gujarat.

2. Material and Methods
The predatory potential of *C. sexmaculata* was studied on *A. craccivora* as prey in the Post Graduate Research Laboratory of Department of Entomology, N.M. College of Agriculture, Navsari Agricultural University, Navsari during January 2022 to March 2022 at 27.18 ± 1.45℃ temperature with a relative humidity of 49.80 ± 7.64 per cent. The aphid infested twigs of Indian Bean, (*Dolichos lablab* L.) and the adults of *C. sexmaculata* were collected from the field and maintained the stock culture of insects under laboratory.

2.1. Larval feeding potential
A set of fifty neonate larvae were reared separately in plastic vials (6 x 4 cm) right from the hatching to pupation to record the larval feeding potential. Each larval instar was provided with a counted number of aphids (nymphs and adults). The number of aphids were increased as the larva entered in to subsequent instar. The number of aphids consumed during 24 hours were obtained by subtracting the number of aphid left over from the total number of aphids

supplied. The fresh new aphids were reintroduced daily during present investigation. Thus, the larval feeding potential was worked out for each instar as well as for entire larval period.

2.2. Adult feeding potential

The newly emerged adults of *C. sexmaculata* on *A. craccivora* were kept separately in plastic vials (6 x 4 cm) to study the feeding potential of adults. A set of fifty male and female adults were supplied with counted number of aphids. Number of aphids consumed during 24 hours was obtained by subtracting the number of aphid left over from the total number of aphid supplied. The fresh new aphids were reintroduced daily throughout the adult period.

3. Results and Discussion

3.1. Larval feeding potential

All the four stages of larvae of *C. sexmaculata* were voracious, feeding actively on the aphids. The early instar pierced the aphid's body and sucked the internal contents, leaving the emptied exoskeleton (Fig. 1). Late instar larva in addition, consumed the whole body by chewing.

3.1.1. First instar

The newly hatched first instar larva initially fed on the chorion of the egg and then moved to feed on aphids. The per day consumption of the first instar larva varied between 5–13 aphids with a mean consumption of 8.42±1.86 aphids. The total consumption of first instar ranged between 7–17 with a mean of 10.78±2.71 aphids (Table 1). The present findings are similar to those reported by Solangi *et al*. (2007) [15] where the number of aphids consumed per day by first instar varied between 6.20–12 aphids when reared on different aphids. Similarly, Singh *et al*. (2008) [13] reported that the per day consumption on *L. erysimi* was 9.68±0.54 aphids but the total consumption varied from the present results as it was reported as 24.23±1.83 aphids. More or less similar observations were obtained by Pandi *et al*. (2012) [7] who noticed that the mean consumption of first instar varied as 4.6–14.2 aphids, when reared on different aphids. This results were further corroborated by the reports of Shinde (2012) [12] and Priyadarshani *et al*. (2016) [9].

3.1.2. Second instar

The per day consumption of the second instar larva varied from 5–17 aphids with a mean of 10.21±3.34 aphids, while the total consumption ranged between 11–33 aphids with a mean of 22.48±4.40 aphids (Table 1). These results are in tally with the findings of Solangi *et al*. (2007) [15] who noticed that the mean consumption of second instar was 20.00–27.00 aphids when reared on different aphid species. Similar results were obtained by Shinde (2012) [12] who reported that the average per day consumption of second instar larva was 14.41±2.54, while total consumption was 24.58±1.51. Priyadarshani *et al*. (2016) [9] mentioned that the per day consumption of second instar larva was 7.5±1.3 aphids when reared on *A. craccivora*. The present findings are in deviation with the results of Singh *et al*. (2008) [13] and Pandi *et al*. (2012) [7]. This could be due to variation in the larval duration, prey density and the prey species used.

3.1.3. Third instar

The per day consumption of the third instar larva ranged between 10–23 aphids with an average of 16.13±2.47 aphids and the total consumption varied between 30–58 aphids with an average of 36.78±6.93 aphids (Table 1). Similar the results were obtained by Solangi *et al*. (2007) [15] who reported that the mean consumption of third instar was 30.5 aphids when reared on *A. gossypi*. The present results are in partial agreement with the results given by Shinde (2012) [12] where the per day consumption varied between 12.16–26.47 aphids and the total consumption ranged between 27.75–53.73 aphids when reared on different aphid species. These results are in disagreement with the earlier reports of Singh *et al*. (2008) [13], Pandi *et al*. (2012) [7] and Priyadarshani *et al*. (2016) [9].

3.1.4. Fourth instar

The data on per day consumption of fourth instar revealed that it ranged between 27–47 aphids with an average of 36.32±3.78 aphids and the total consumption varied between 74–145 with an average of 119.12±18.18 aphids (Table 1). The present results are in agreement with the reports of Solangi et al. (2007) [15] who reported that the mean consumption of fourth instar larva was 115.87 when reared on maize aphid, *R. maidis*. Pandi *et al*. (2012) [7] noticed that the mean consumption of fourth instar larva was 116.8±2.58 when reared on *L. erysimi*. More or less similar results were obtained by Shinde (2012) [12] when reared on different aphids. Among all, the fourth instar was a voracious feeder and consumed a greater number of aphids. This could be attributed to larger size, longer duration of the fourth instar which necessitates higher intake, as well as the requirement to accumulate nutrients for the pupal period (Pandi *et al*., 2012) [7]. The higher attack rate and the lower handling time of the prey by the fourth instar also facilitates higher consumption (Gupta *et al*., 2012) [3].

3.1.5. Total larval feeding potential

The data presented on feeding potential of *C. sexmaculata* during its entire larval period revealed that the total consumption varied between 125–239 aphids with an average of 189.16±25.28 aphids (Table 1). More or less similar results were obtained by Shinde (2012) [12] when reared on different aphids.

3.2. Adult feeding potential

The adult attacked the aphid and consumed the whole prey by chewing (Fig. 2). The data obtained on feeding potential of adult revealed that the per day consumption in females varied between 16–58 aphids with a mean of 35.54±11.66 aphids in females while in males it was 11–54 aphids with a mean of 32.67±10.92 aphids. The total consumption was enumerated and it ranged between 642–842 aphids with an average of 760.62±49.33 aphids and in males it was 622–458 aphids with an average of 555.4±41.63 aphids. The present results are in close agreement with the findings of Pandi *et al*. (2012) [7] who found that the per day mean consumption in males and females was 37.2±3.323 and 35.8±2.67 aphids, respectively when reared on *A. craccivora*. More or less similar observations were recorded by past workers. Bhadauria *et al*. (2001) [2] mentioned that per day consumption of adult *C. sexmaculata* was 28.0 individuals. Shinde (2012) [12] noticed that per day aphid consumption in female and male was 20.69 ± 1.20 and 20.33 ± 2.86 and the total aphid consumption was 789.92 ± 32.72 and 491.60 ± 33.05, respectively. This shows that the female consumed more number of aphids as compared to males. This could be due to the nutritional

requirements to meet the reproductive attributes and also the higher longevity in females compared to males. The higher attack rate and the lower handling time in females also helps in higher consumption of the prey (Gupta *et al*., 2012; Mrosso *et al*., 2013) [3, 4].

Table 1: Feeding potential of larva and adult of *Cheilomenes sexmaculata* on *Aphis craccivora*

Stages	No. observed	Per day consumption of aphids (No.s)			Total consumption of aphids (No.s)		
		Min.	Max.	Mean ± S.D	Min.	Max.	Mean± S.D
Larva							
I instar	50	5	3	8.42±1.86	7	17	10.78±2.71
II instar	50	5	17	10.21±3.34	11	33	22.48±4.40
III instar	50	10	23	16.13±2.47	30	58	36.78±6.93
IV instar	50	27	47	36.32±3.78	74	145	119.12±18.18
Total consumption	50	-	-	-	125	239	189.16±25.28
Adult							
Female	50	16	58	35.54±11.66	642	842	760.62±49.33
Male	50	11	54	32.67±10.92	622	458	555.4±41.63

Fig 1: Larva of *Cheilomenes. sexmaculata* feeding on *Aphis craccivora*

Fig 2: Adult of *Cheilomenes sexmaculata* feeding on A*phis craccivora*

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References

1. Bale JS, Van Lenteren JC, Bigler F. Biological control and sustainable food production. Philos. Trans. R. Soc. Lond. B Biol. Sci. 2008;363(1492):761-776.
2. Bhadauria SS, Jakhmola SS, Bhadauria, N. S. Biology and feeding potential of *Menochilus sexmaculatus* on different aphids. Indian J Entomol. 2001;63(1):66-70.
3. Gupta RK, Pervez A, Guroo MA, Srivastava, K. Stage-specific functional response of an aphidophagous ladybird, *Coccinella septempunctata* (Coleoptera: Coccinellidae), to two aphid species. Int. J Trop. Insect Sci. 2012;32(3):136-141.
4. Mrosso F, Mwatawala M, Rwegasira, G. Functional responses of *Cheilomenes propingua*, *C. lunata* and *C. sulphurea* (Coleoptera: Coccinellidae) to predation on *Aphis gossypii* (Homoptera: Aphididae) in Eastern Tanzania. J Entomol. 2013;10(2):76-85.
5. Naranjo SE, Ellsworth PC, Frisvold GB. Economic value of biological control in integrated pest management of managed plant systems. Ann. Rev. Entomol. 2015;60:621-645.
6. Omkar, Pervez A. Biodiversity of predaceous coccinellids (Coleoptera: Coccinellidae) in India: a review. J. Aphidol. 2000;14:41-66.
7. Pandi G, Paul B, Vivek S, Shankarganesh K. Feeding potential and biology of coccinellid predator *Cheilomenes sexmaculata* (Fabricius) (Coleoptera) on aphid hosts. Indian J. Entomol. 2012;74(4):388-393.
8. Pervez A, Harsur, MM. Coccinellids on crops: Nature's gift for farmers. In Innovative Pest Management Approaches for the 21st Century. Springer, Singapore, 2020, 429-460.
9. Priyadarshani TDC, Hemachandra, KS, Sirisena UGAI, Wijayaguasekara HNP. Developmental biology and feeding efficiency of *Menochilus sexmaculatus* (Coleoptera: Coccinellidae) (Fabricius) reared on *Aphis craccivora* (Koch) (Hemiptera: Aphididae). Trop. Agric. Res. 2016;27(2):115-122.
10. Routray S, Hari Prasad KV, Dey D. Effect of *Aphis craccivora* Koch. reared on different host plants on the biology of *Cheilomenes sexmaculata* (Fabricius). J. Biol. Control. 2016;30(1):19-24.
11. Shanmugapriya V, Muralidharan CM, Karthick K. Biology and bionomics of zig zag beetle *Cheilomenes sexmaculatus* Fabricius (Coleoptera: Coccinellidae). Int. J. Curr. Microbiol. App. Sci. 2017;6(3):541-548.
12. Shinde CU. Bio-ecology and utilization of predatory coccinellids for the management of aphids under south Gujarat condition. Thesis Ph.D., Navsari Agricultural University, Navsari, Gujarat, 2012, 280.

13. Singh YP, Meghwal HP Singh SP. Biology and feeding potential of *Cheilomenes sexmaculata* Fabricius (Coleoptera: Coccinellidae) on mustard aphid. Ann. Arid Zone. 2008;47:185-190.
14. Smith HS. On some phases of insect control by the biological method. J Econ. Entomol. 1919;12(4):288-292.
15. Solangi BK, Hullio MH, Baloch N. Biological parameters and prey consumption by zig zag beetle, *Menochilus sexmaculatus* Fab. against *Rhopalosiphum maidis* (Fitch), *Aphis gossypii* Glover and *Therioaphis trifolii* Monell. Sarhad J Agric., 2007;23(4):1097-1101.