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Feeding potential of *Cheilomenes sexmaculata* (Fab.) on different species of aphid

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Abstract
Experiment on the predatory potential of grub and adult stage of *C. sexmaculata* on five different species of aphid, *viz*., mustard aphid, *L. pseudobrassicae*, cotton aphid, *A. gossypii*, maize aphid, *R. maidis*, cowpea aphid, *A. craccivora* and gaillardia aphid, *U. compositae* was conducted under laboratory condition at Department of Agricultural Entomology, B. A. College of Agriculture, Anand Agricultural University, Anand. The highest (21.67±1.31) number of *A. craccivora* individuals were consumed by first instar. Second instar preferred *R. maidis* (34.27±0.86), while third and fourth instar grubs were fed on *A. gossypii*, with consumption 57.13±1.02 and 79.87±0.77, respectively. Significantly, the highest (188.6±1.62) number of *A. gossypii* were consumed by grub than rest of aphid species. The maximum (828.2±7.96) numbers of *A. craccivora* was consumed by the adult of *C. sexmaculata*. Total consumption by *C. sexmaculata* in its entire life time was more on *A. craccivora*.

Keywords: *Cheilomenes sexmaculata*, aphids, feeding potential

1. Introduction
Coccinellids are known to have the strongest impact among all aphidophagous insects in aphid population regulation (Hodek, 1970; DeBach and Huffaker, 1971) [3, 2]. A generalist entomophagous coccinellid, the zigzag beetle feeds are bright yellow in colour, these mature beetles have black vertical zigzag lines on the dorsal side of both elytra. Within the species, there are polymorphs with varying colorations. The zigzag beetle, *Cheilomenes sexmaculatus* Fabricius is a widespread and frequent species that feeds on aphids in countries including India, Pakistan, Borneo, Jawa, Indonesia, United Kingdom, Philippines, Islands of Bali, France, Sumatra, and South Africa (Lokhande and Mohan, 1990) [4]. A common ladybird beetle, *C. sexmaculata* as the predominant species in middle Gujarat, which play important role in checking population of aphid in different crops (Tank *et al*., 2010) [8]. Because they are effective and persistent in their effects, biological control procedures are successfully implemented to eliminate insect pests. The present study was planned to determine prey consumption of the *C. sexmaculata* of five different species of aphid under laboratory conditions.

2. Materials and Method
The adults of *C. sexmaculata* were collected from the mustard field and reared under laboratory conditions at 27.20 ºC average temperature and 55.90 per cent relative humidity on mustard aphid in plastic jar. The mouth of plastic jar was cover with muslin cloth. Fresh leaves of mustard with aphids hosts were provided daily as oviposition substrate for female beetles. The eggs laid by female beetles were transferred to plastic vials for further rearing. A total of 15 grubs of *C. sexmaculata* were reared individually on different species of aphids *viz*., mustard aphid, *L. pseudobrassicae*; cotton aphid, *A. gossypii*; maize aphid, *R. maidis*; cowpea aphid, *A. craccivora* and gaillardia aphid, *U. compositae* in plastic vials right from the first day of hatching to the formation of pupae. Initially 15 aphids were provided, but with the gradual development of grubs, the number of aphids were increased proportionally. The number of aphids consumed by individual grub was recorded daily. The feeding potential was worked out for individual instars as well as for entire grub period. The newly emerged adults of coccinellid were kept individually in plastic jar and each adult was provided with aphids for entire adult period and the feeding potential of adult was worked out.

3. Result and Discussion

An attempt was made to determine the relative predatory potential of *C. sexmaculata* on five different species of aphid *viz*., Mustard aphid, *Lipaphis pseudobrassicae*; cotton aphid, *Aphis gossypii*; maize aphid, *Rhopalosiphum maidis*; cowpea aphid, *Aphis craccivora* and gaillardia aphid, *Uroleucon compositae.* The data on consumption capacity of *C. sexmaculata* towards five different species of aphids are presented in Table 3.1. The data revealed that significantly the highest (21.67±1.31) number of *A. craccivora* individuals were consumed by the first instar grub of *C. sexmaculata*. The first instar grubs consumed 19.47±0.45 individuals of *A. gossypii* followed by *L. pseudobrassicae* (10.80±0.69), *R. maidis* (10.73±0.64) and *U. compositae* (9.87±0.29). While in case of second instar grub, the highest (34.27±0.86) number of individuals of *R. maidis* were consumed followed by *A. craccivora* (32.93±1.09) and *A. gossypii* (32.13±0.77). Significantly, less consumption was found of *L. pseudobrassicae* (19.00±1.61) and *U. compositae* (19.67±1.26). The highest number of *A. gossypii* (57.13±1.02) were consumed by third instar grub which was followed by *A. craccivora* (54.67±2.89) and *R. maidis* (49.8±1.07). Significantly the lowest (27.8±3.80) number of *L. pseudobrassicae* were consumed by third instar grub followed by *U. compositae* (29.73±1.06). The fourth instar grub showed the identical trend in feeding preference as observed in case of third instar grub. Maximum (79.87±0.77) number of *A. gossypii* was fed by fourth instar grub. *A. craccivora* (67.4±2.86) stood relatively less preferred aphid species than *A. gossypii* followed by *R. maidis* (57.47±3.51). Significantly the least (40.53±2.76) number of *U. compositae* were consumed by fourth instar grub followed by *L. pseudobrassicae* (42.20±2.61). Total number of aphids consumed during entire grub period varied from 99.80 to 188.60. Significantly the highest (188.6±1.62) number of *A. gossypii* were consumed by grub than rest of aphid species. The grub consumed an average of 176.67±3.21, 152.27±2.77, 99.8±7.32 and 99.8±2.73 individuals of *A. craccivora, R. maidis, U. compositae* and *L. pseudobrassicae,* respectively. Maximum (828.2±7.96) number of *A. craccivora* was fed by the adult of *C. sexmaculata* followed by *A. gossypii* (714.87±8.62), *R. maidis* (502.27±44.13), *U. compositae* (387.73±34.05) and *L. pseudobrassicae* (361±23.19). The adult consumed significantly more number of individuals of *A. gossypii* than *R. maidis, U. compositae* and *L. pseudobrassicae*. Total consumption of aphids by both of the feeding stages (grub and adult) of *C. sexmaculata* varied from 460.80 to 1004.87 individuals. Significantly, maximum (1004.87±9.39) numbers of *A. craccivora* were consumed by the *C. sexmaculata* than other species of aphids. The aphid, *A. gossypii* (903.47±9.23) was a preferred host for *C. sexmaculata* next to *A. craccivora*. The predator, *C. sexmaculata* consumed 654.53±45.30 individuals of *R. maidis* during its entire lifespan. The aphid, *L. pseudobrassicae* was proved to be less preferred host by *C. sexmaculata* as 460.8±28.49 individuals were consumed followed by *U. compositae* (487.53±35.50).

The present findings are agreement with earlier scientists (Zala, 1995 and Chakraborty, 2012) [9, 1] who found *L. erysimi* was less preferred host by *C. sexmaculata*. Shinde (2012) [5] and Singh (2020) [6] reported that the total consumption by *C. sexmaculata* in its entire lifetime was more on *A. craccivora* and the least on *L. erysimi.* Solangi *et al.* (2007) [7] reported that *C. sexmaculata* grubs and adults were voracious feeders on corn leaf aphid, *R. maidis* (49.47 and 82.50), cotton aphid, *A. gossypii* (25.04 and 72.00) and alfalfa aphid, *T. trifolii* (57.11 and 74.00).

Table 1: Feeding potential of *C. sexmaculata* on different species of aphid

Tr. No.	Aphid species	Mean No. of aphids consumed by different feeding stages (n=15)						
		Grub instar				Grub	Adult	Mean No. of aphids consumed/ individual
		1st	2nd	3rd	4th			
T_1	Mustard aphid, *L. pseudobrassicae*	10.80±0.69 (8-14)	19.00±1.61 (15-23)	27.80±3.80 (22-37)	42.20±2.61 (38-60)	99.80±7.32 (340-579)	361.00±23.19 (16-131)	460.80±28.49 (16-710)
T_2	Cotton aphid, *A. gossypii*	19.47±0.45 (17-22)	32.13±0.77 (27-36)	57.13±1.02 (57-63)	79.87±0.77 (73-90)	188.60±1.62 (600-850)	714.87±8.62 (175-210)	903.47±9.23 (794-1038)
T_3	Maize aphid, *R. maidis*	10.73±0.64 (9-12)	34.27±0.86 (30-38)	49.80±1.07 (44-53)	57.47±3.51 (47-67)	152.27±2.77 (484-659)	502.27±44.13 (142-173)	654.53±45.30 (158-801)
T_4	Cowpea aphid, *A. craccivora*	21.67±1.31 (19-25)	32.93±1.09 (28-38)	54.67±2.89 (44-61)	67.4±2.86 (60-75)	176.67±3.21 (683-914)	828.20±7.96 (162-188)	1004.87±9.39 (864-1078)
T_5	Gaillardia aphid, *U. compositae*	9.87±0.29 (8-12)	19.67±1.26 (14-23)	29.73±1.06 (25-34)	40.53±2.76 (36-54)	99.80±2.73 (315-555)	387.73±34.05 (83-118)	487.53±35.50 (438-669)
SEm±		0.54	0.82	1.62	1.89	2.86	19.45	20.73
CD at 5%		1.59	2.42	4.78	5.56	8.43	57.37	61.16
CV (%)		5.25	4.21	5.23	4.64	2.01	5.49	4.18
Note: Figures in parentheses are range values								

4. Conclusion

The present investigation revealed that total consumption by *C. sexmaculata* in its entire lifetime was more on *A. craccivora*. The feeding potential of adults of *C. sexmaculata* was higher than the grubs. The fourth instar grub consumed more aphids than the first, second and third instars.

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