Studies on Functional Response of Grub and Adult of C. *septempunctata* (L.) on *Aphis pomi*

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Abstract:
Studies were conducted in the laboratory of aphid management, Division of Entomology, Sher-e-Kashmir University of Agricultural Science and Technology - Kashmir, to determine the effect of different prey (aphid) densities (functional response) of second, third, fourth instars of grub and adult of important aphidophagous coccinellid, C. *septempunctata (L.)* i.e. 20, 40, 80, 100, 200, 400 and 800. The present study revealed that the prey density has significant influence on the preying capacity of the grub and adult of species. Prey consumption by the second, third, fourth instars of grub and adult of C. *septempunctata (L.)* followed an increasing trend from lower prey density (20) to higher prey densities i.e. 40, 80, 100, 200, 400 and 800, while the percentage of prey consumption decreased with increasing prey (aphid) densities.
Keywords: Functional response, coccinellid, *C. septempunctata,* prey, aphidophagous

Introduction
Ladybeetles (Coccinellidae: Coleoptera) are amongst the most familiar and important groups of insects. Majority of them, excluding most of the members of the subfamily Epilachninae, are predaceous on injurious insects, viz. aphids, mealy bugs, scale insects, thrips, leafhoppers, mites and other soft-bodied insect pests of the agricultural and horticultural crops (Omkar and Parvez, 2000). Coccinellids are important predators in natural and agricultural habitats (Hodek and Honek, 1996). In agricultural habitats, Coccinellids prey upon many economically important pests, including aphids and soft-bodied insects (Metcalf and Luckman, 1994). In natural areas, Coccinellids check outbreaks of a variety of herbivores and many species of aphids. Predators react to the density of prey in several ways which was first described and defined by Solomon (1949) and then analysed in a complex manner by Holling (1959, 1965). The functional response of a predator is a key factor regulating the population dynamics of predator-prey systems. It describes the rate at which a predator kills its prey at different prey densities and can thus determine the efficiency of a predator in regulating prey populations (Murdoch and Oaten 1975). In many studies, it is known that C. *septempunctata,* commonly called Ladybird beetle is a capable predator and can be used for the biological control of *T. tabaci* and *T. vaporariorum* in a greenhouse (Solomon, 1949). The ladybird beetle, C. *septempunctata* (Coleoptera: Coccinellidae) is an important polyphagous Coccinellid species throughout the world. It feeds on diverse pest species including aphids, thrips, whiteflies, mites and lepidopteron eggs (Omkar and Parvez, 2004)

Materials and Methods

This study was conducted in the Laboratory of aphid management, Division of Entomology, Sher-e-Kashmir University of Agricultural Science and Technology - Kashmir, Srinagar to determine the feeding efficiency of second instar, third instar, fourth instar grub and adult on different prey (aphid) densities of *Aphis pomi* i.e. 20, 40, 80, 100, 200, 400 and 800 with a single predator. The experiment was conducted in a Petri dish (15×2 cm) having moistened filter paper at the bottom. A counted number of second and third instar *Aphis pomi* nymph with fresh apple twig were placed and then allowed to settle. The feeding efficiency of the predator in relation to prey number of each (second, third, fourth instars grub and adult) stage was observed separately at varying aphid densities. All the treatments were replicated 10 times and observations was recorded every 24 hour interval. 24 hour starved predator grub and adult were utilised. The numbers of unconsumed aphids were counted to ascertain the feeding potential of the predator.

Results and Discussions

The feeding efficiency of fourth instar grub on average consumed 19.9 ± 0.04 aphids when the aphid density was 20, which is 99.8 of the total aphid population in the case of *C. septempunctata*. The average consumption of different stages of *C. septempunctata*, when the corresponding prey density was maintained at 40, 80, 100, 200, 400 and 800 (**Table 1)**. This study revealed that the functional response of fourth instar grub was found to be the maximum followed by the third instar grub, adult and second instar grub of *C. septempunctata.* The present finding evidenced that the prey density has a significant influence on the rate of prey consumption. Several workers reported that the predator feeds on more aphids at higher density because the probability of contact was greater at higher prey density than at lower density. This study confirmed the results of the study of Marks (1977) which reported that C. *septempunctata* is unable to detect its prey either by vision or by olfaction and the search is random (Murdoch and Marks 1973). The probability of contact with the prey at a higher density would tend to increase per unit area.

Conclusion

From this study, it was concluded that the aphid density greatly affected the feeding potential. At higher density, predation was higher and at lower density, the rate of predation was observed to be a low amount of food. This seems to be a good quality of the predator to feed more at higher prey density and feed less at lower prey density. This quality not only allows the predators to survive at lower density by consuming less but also helps in reducing the prey population by eating more at higher prey densities. This kind of response of the predator indicates their host searching capacity, which increases with prey population, reflecting its suitability as a bio-control agent of mustard aphid.

Table 1. Feeding efficiency of grub and adult of *C. septempunctata* L. on *Aphis pomi*

Prey (aphid density)	Second Instar		Third Instar		Fourth Instar		Adult	
	Av. Prey Consumed ±SEM	Av.(%) Prey Consumed ±SEM	Av. Prey Consumed ±SEM	Av.(%) Prey Consumed ±SEM	Av. Prey Consumed ±SEM	Av.(%) Prey Consumed ±SEM	Av. Prey Consumed ±SEM	Av.(%) Prey Consumed ±Sem
20	13.7 ± 0.35	68.6 ± 1.79	19.7±0. 12 9	8.5 ± 0.71	19.9 ± 0.04	99.8 ±0.19	18.5 ± 0.38	91.0 ± 3.26
40	21.9 ± 0.37	54.7±0.92	36.9 ± 0.40	92.2 ± 1.13	39.4 ±0.22	98.6 ± 0.55	31.2±0.45	78.1 ± 1.13
80	39.5 ± 0.44	53.0 ±3.97	61.8 ± 1.35	77.3 ± 1.89	71.9±0.70	89.6 ± 0.86	53.2±1.40	66.5 ± 1.75
100	52.5±0.77	52.5±0.77	74.5 ±0.62	74.5 ± 0.62	78.8 ± 1.10	78.8 ±1.10	67.2 ±2.02	67.2 ±2.02
200	72.9 ±0.60	36.5 ± 0.29	119.1 ±1.04	59.6 ± 0.52	143.5 ±3.26	71.1 ± 1.63	104.4 ± 0.89	51.9 ± 0.51
400	88.8 ± 1.60	22.2 ±0.40	170.1 ± 0.97	42.5 ±0.24	192.6± 2.02	48.2 ±0.51	126.9 ±1.24	31.8 ± 0.31
800	108.9 ± 0.91	13.6 ± 0.11	246.5 ±1.92	30.8 ±0.24	287.7± 2.73	36.1 ±0.38	171.3 ± 1.08	21.4 ± 0.13

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