INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2002/04–1–110–112
http://www.ijab.org

Prey Preference and Switching Behaviour of *Coccinella septempunctata* L. (Coleoptera: Coccinellidae)

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ABSTRACT

The relationship between the predator and their prey was evaluated in the laboratory on feeding three prey species *Myzus persicae, Rohpalosiphum padi and Bravicoryne brassicae.* Mixed instars of each prey were supplied in the individual arena to a single adult *Coccinella septempunctata*. The prey consumption and rate of egg production were significantly higher when feeding on *M. persicae* in comparison with two other prey species. The development rate was significantly inferior when the predator fed on *B. brassicae*. The predators innate factors determined a significantly higher oviposition rate on natural host than non host. The morphological factor of the host prey had great influence on the prey preference and switching behaviour of the predator.

Key Words: Prey preference; Morphological factors; Physical responses; Behaviour

INTRODUCTION

In nature, the generalist predators are not much particular in responding to the prey numbers, types and sizes but the host specific species do so. This characteristic is called the prey preference. The term preference for particular prey type is here by defined as choosing the prey as more desirable food. Hassell (1978) reported that polyphagus predators exhibit preference for one or more prey types when exposed to a variety of prey species. In previous studies, the preference was measured from the proportion of prey species eaten out of mixed prey species offered. The differences in proportion of prey species eaten from the available prey species indicates the preference level described (Mealzer, 1978; Hussein, 1991; Elliot *et al.*, 2000). Although, *Coccinella septemputcata* is a famous generalist predator having a wide range host prey but the switching behaviour takes place when exposed to the variety of prey species. Whether or not *C. septempunctata* will exhibit preference for any particular prey species, stage and size, is still not recorded. To determine the level of prey preference and switching behaviour of *C. septempunctata* L. against the target pest *Myzus persicae* as principle prey, and *Brevicoryne brassicae and Rhopalosiphum padi* as alternate prey, this study was conducted.

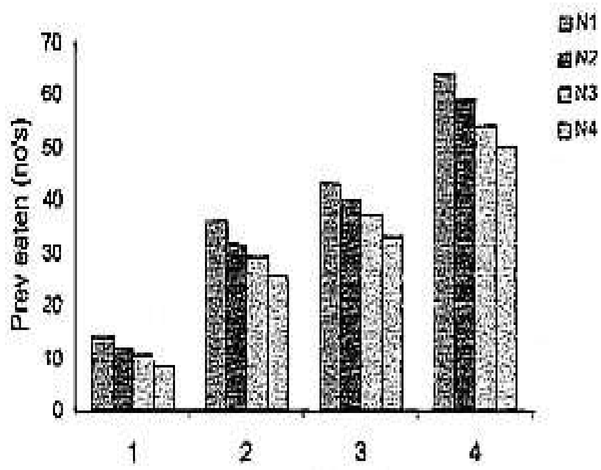
MATERIALS AND METHODS

This experiment was conducted in the laboratory under fluorescence illumination of 12:12(L:D) with varying temperatures (25 to 30ºC) and RH (54 to 75%). The prey species tested were *M. persicae* (Mp), *Brevicoryn brassicae* (Bb) and *Rhopalosiphum padi* (Rp). Both predator and prey species were taken from the laboratory rearing stock culture. The body size of the predator and live prey were measured with the aid of ocular micrometer disc attached on the stereomicroscope. The prey preference was recorded using following methods descried by Hassell (1978) as difference between the proportion of prey consumed and prey presented. Four developmental stages of aphid prey (N_1, N_2, N_3 and N_4) were used by larval instars (L_1, L_2, L_3, L_4) of *C. septempunctata.* The aphids were introduced in the arena by fine camel hair brush (No. 0.00). Two hour pre-starved larvae and adults were tested for 12 h in day light. For testing the prey density, seven feeding regimes were supplied from each prey species at 8, 16, 24, 32, 40, 48 and 56 aphids/arena. The aphids were supplied in a petri dish arena. Each day the treatment combination was randomized. The maximum period was allowed for 100% predation. The proportion of prey eaten with in prescribed period was recorded after every 12 h. Adult aphids were not used in the experiment because they produce progeny and could change the prey number. The proportion of prey consumed was plotted against the number of prey initially offered. The preference degrees were used from no preference (Zero value) in which not a single prey taken to complete preference (maximum positive value).

RESULTS AND DISCUSSION

Preference for various developmental stages of prey. The graphical analysis of various developmental stages of *C. septempunctat*a over a range of developmental stages of aphid (Fig. 1) showed a significantly higher preference to the first and second nymphal instars in comparison with third and fourth. The attack rate and prey handling time for (first instar larvae) of *C. septempunctata* against first nymphal stage was 0.0224 aphids/h and 0.0398/aphid against the fourth nymphal stage. The young *C. septempunctata* (first and second instar) seemed to prefer the first over the other nymphal instars of the prey (Table I). There was a maximum negative proportion of

Fig. 1. The graphical bars show the rate predation that mean determined by LSD



difference observed on the fourth nymphal instar of the prey against first instar predator larvae. Although the older predator larvae (third and fourth instar) were much efficient in capturing the prey irrespective of their size but still the rate of predation on first and second nymphal stage prey remained higher.

These results concur with those of Hussein (1991) dealing with various prey developmental stages of *Menochilus sexmaculatus.* Relatively, same results were reported earlier by (Dixon, 1959; Mealzer, 1978) dealt with *Adalia decempunctata* (L.) preying on *Microlosiphum avnnsi.* The study revealed that first to fourth instar larvae showed a preference to first and second nymphal instars over third and fourth and the prey handling time was significantly higher when the predator fed upon fourth instar prey nymph.

Preference of predator to various prey species. The attack rate and handling time for *C. septempunctata* against *R. padi* and *B. brassicae* was compared with *M. persicae,* the principle host prey. The preference degree varies from no preference zero (value) to complete preference (maximum positive value). The results revealed that all four instars and adults showed week preference to the *B. brassicae,* which might be due to the morphological factor of the prey. All developmental stages of *B. brassicae* were thoroughly covered with wax, which may serve as deterent for the predator. The rate of prey rejection in case of *B. brassicae* over two other prey species was significantly higher (Table II). These results are supported by Hassell (1978) whereby the preference was due to the morphological character of the prey species.

Table II. The foraging activity of adult *C. septempuctata* exposed to various prey species

Prey type	Frequency of prey recognition	% Avoidance attack	% Prey that escape	% Prey captured by *C. septempunctata*
M. persicae	73.33	23.33	4.30	47.80
B. brassicae	29.98	80.87	3.20	8.10
R. padi	59.55	17.76	2.80	12.3

The prey size is not only the factor for the predators preference as Curio (1976) suggested that a prudent predator would only prefer the bigger prey. However, it was observed that the *R. padi* and *B. brassicae* were bigger in size which were not preferred by any developmental stage of the predator over *M. persicae.* These results are relatively same as reported earlier (Cock, 1978) who had categorized the strong and week preferences with various predator and prey species.

In order to judge the degree of preference from the range of no preference to complete preference was clarified by measuring the proportion of prey attacked and the proportion of prey available. The term complete preference is used for the predator, which only prefers the particular prey type and the term "no preference" used for difference between the proportion presented and proportion of prey eaten.

Switching behaviour of *C. septempunctata.* The predators previous feeding experience had an effect on prey selection when exposed in a multiple prey choice arena. The *C. septempunctata* previously fed on *R. padi* were released in free choice arena of three prey species *M. persicae, B. brassicae* and *R. padi.* The *R. padi* was highly (80%) preferred over other two prey species (Table III). The element of switching found common when *C. septempunctata* fed on *M. persicae*. in ancestry and released against the target pest of two other aphid prey species. A significantly strong switching behaviour takes

Table I. Effect of prey size and stage on prey preference of *Coccinella septempunctata*

	L1				L2				L3, L4 and adult			
S. No.	N1	N2	N3	N4	N1	N2	N3	N4	N1	N2	N3	N4
1	10	5	–	–	20	10	–	–	20	20	20	20
2	10	–	5	–	20	–	10	–	20	30	15	15
3	10	–	–	5	20	–	10	–	24	20	15	20
4	5	5	5	5	10	10	10	10	25	10	30	15
Total	35	10	10	10	70	20	30	10	90	80	80	70

L1, L2, L3, L4: First, second, third and fourth larval instar of *C. septempunctata;* N1, N2, N3, N4: First, second, third and fourth nymphal instar of *M. persicae* place in response to previous feeding experience (Table III).

Table III. Effect of predators previous experience on preferences when the predator exposed to various prey species

Predation	Previous experience	*M. persicae*	*B. brassicae*	*R. padi*
Prey eaten/ individual	fed on Mp	43.28±1.65	4.5±0.63	6.8±0.43
Prey eaten/ individual	fed on Rp	5.3±0.43	4.7±0.10	38.12± 0.45
Prey eaten/ individual	fed on Bb	6.10±0.84	25.6±2.9	4.84±0.64
Average prey length (mm)		0.5±0.58	0.9±0.00	0.7±0.00
Prey handling time (s)		83.5±4.30	124±9.45	98±7.78
Egg production/day		31.4±0.96	8.3±1.55	6.7±1.35

The study revealed that the previous feeding experience of *C. septempunctata* has great influence on the altering feeding behaviour and prey consumption. The *B. brassicae* was not preferred at all by both immature and adult developmental stages when exposed to a multiple prey arena. But a trend of switching was occurred towards the *B. brassicae* when predator previously fed on the same prey species.

In conclusion, there was no strong preference for bigger size prey. A weak preference for *B. brassicae* was shown may be due to the wax on the integument of the prey. The previous feeding experience has shown a great influence in prey preferences.

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(Received 11 October 2001; Accepted 12 November 2001)