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Effect of Prey and Predator age on the Feeding Preference and rate of Predation by two Predators *Coccinella transversalis* Fab. and *Cheilomenes sexmaculatus* (Coleoptera : Coccinellidae)

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ABSTRACT

The feeding preference of two coccinellid predators namely, *Coccinella transversalis* F. and *Cheilomenes sexmaculatus* F. on different instars and forms of the aphid, *Aphis gossypii* Glov. and predator age-dependent interference on the rate of predation were investigated. Significant differences were observed among the predatory stages for various prey ages. Older predators fed on older preys. However, adult beetles did not show any marked preference and fed on all stages and forms of preys. The various combinations of adults and grubs at different levels significantly affected the prey consumption levels. Among the various treatments, the treatment with 12 predators consumed the maximum number of aphids at all prey levels followed by 12 adults + one instar grub indicating the addition of a grub did not increase the prey consumption of adults.

KEY WORDS : *Cheilomenes sexmaculatus* , *Coccinella transversalis*, *predation*, *Aphis gossypii*

Coccinellids are mostly polyphagous beetles with a wide host range of accepted food ranging from coccids to aphids (Hodek, 1965) and the rate of feeding has been reported to be widely changing depending on the stage, and sex of the predator and also on the size of the prey. The prey consumption is known to be positively correlated with the population density of the prey (popov, 1960) and the age of the predator has influence on the prey consumption (Choi and Kim, 1985). Likewise, aged grubs appeared to have a depressing effect on the feeding of younger stages (Murdoch and Andrew Sih, 1978). The present investigation was initiated to study the prey age preference of predators and predator age interference on the rate of predation under laboratory conditions.

MATERIALS AND METHODS

Potted brinjal plants of the var. Panruti local were maintained continuously in the insectary. *Aphis gossypii* Glover, collected from brinjal fields were released on the third leaf of 40 days old plants. The plants with aphids were then covered with a muslin cloth bag on bamboo frame and the aphids were allowed to multiply. In another set of plants, *A. gossypii* were introduced and allowed to reproduce so as to have a thick population. The plants were then arranged in two rows within an iron cage covered with muslin cloth. Adult coccinellids of both *Coccinella transversalis* F. and *Cheilomenes sexmaculatus* F. collected from fields were then released separately. The beetles were allowed to feed on aphids and multiply. The plants were replaced with fresh ones as and when required so as to maintain a continuous supply of aphids for the growth and development of the coccinellids.

Individual predatory grubs of I, II, III and IV stage and adults from the stock culture were taken in Petri dishes separately and provided with 20 numbers of either I, II, III and IV instar aphid nymphs, parthenogenetic female or winged aphids on brinjal leaves. The experi-

ment was replicated three times and conducted at a temperature of 28 ± 1^{0}C. The preference for a particular category of prey by the predator was worked out as per the number consumed in 24 h time. A set of control dishes was also maintained to find out the natural mortality of the aphids. The mean level of prey preference shown by different predatory stages was tested using analysis of variance for two way classification and were compared by using DMRT.

To evaluate the relative contribution of different components of predation, three experiments were carried out as per the procedures described by Murdoch and Andrew Sih (1978). In each case, the presence or absence of a component constituted the treatment. The treatments were fixed mainly to study the functional and developmental responses of predators. The experiment was carried out in Petri dishes. The design was as follows:

A - six adults (Functional response)
B - Twelve adults (Functional response)
C - One male + two females + four instar grub (Functional & Developmental response)
D - One male + two females (Functional response)
F - Four II instar grubs (Functional response)
G - Four III instar grubs (Functional response)
H - Four IV instar grubs (Functional response)
I - Six adults + one I instar added/day (Functional & Developmental response)
J - Twelve adults + one I instar added/day (Functional & Developmental response)
K - One male + two females + four I instar grubs added/day (Functional & Developmental response)

Predator numbers were ensured each day. The density of adults was maintained by replacing those that died. However, young ones were allowed to develop and were not replaced when they died. Every day, aphids of constant size were added at levels of 50, 100, 150, 200, 250, 300, 350, 400, 450 and 500 as prey. Each morning the prey insects surviving from the previous day were removed and counted. Each experiment was replicated three times and control dishes were maintained with the same number of aphids but without predators.

Analysis of variance technique was used to analyse the data and the means were compared using DMRT.

Table 1. Number of prey consumed/day by the coccinellid predators* (Mean of three observations)

Stage of the predator	Stage of the Aphid					
	I	II	III	IV	Parthenogenetic female	Winged aphid
C.transversalis						
I stage grub	7.6a	2.0b	2.3b	2.0b	0.0	0.0
II stage grub	1.7c	4.3a	4.3a	4.0a	2.7b	0.0
IV stage grub	1.0c	5.7a	4.0a	3.7b	3.7b	3.3b
IV stage grub	2.3d	7.3ab	8.3a	4.7c	3.0d	2.3d
Male	5.7c	12.0ab	13.7a	7.3c	4.3c	3.0d
Female	10.7d	12.0bcd	14.0abc	15.7a	14.3ab	1.33e
M.sexmaculatus						
I stage grub	6.0a	2.0b	1.0bc	0.7c	0.0	0.0
II stage grub	2.7b	2.0b	2.3ab	3.0a	2.3ab	0.3c
III stage grub	3.7ab	4.7a	3.7ab	3.0ab	4.0ab	0.0
IV stage grub	1.7b	2.0ab	2.7a	1.3b	2.7a	0.3c
Male	10.7ab	11.7a	11.3ab	4.3c	1.0d	0.0
Female	14.0ab	15.0a	11.7c	9.0d	5.7e	1.3f

* Means followed by similar letters within the predator species in vertical columns are not different statistically (p=0.05) by D.M.R.T.

Table 2. Age - dependent interference in *C. transversalis* (I) and *C. sexmaculatus* (II) in terms of prey aphid consumption at various combination of stages of predators* (Mean of three observations)

Prey aphid density (No./leaf)	Predator	Number of prey consumed/day												
		A	B	C	D	E	F	G	H	I	J	K	L	S.E
50	I	42ab	50a	35ab	32b	30b	34a	40ab	38b	43ab	50a	36ab	5c	6.870
	II	40c	48b	32e	29f	27g	36d	32e	32e	40c	50a	31e	6h	0.0213
100	I	84cd	100a	68g	63h	61h	67g	60e	75f	86c	98ab	74f	12i	0.883
	II	81c	97a	60g	42I	37j	58h	72e	68f	77d	89b	60g	13k	0.136
150	I	140abc	150a	105d	100d	84d	94d	101d	110bcd	118bcd	148ab	106d	20e	11.070
	II	132b	140aa	68g	81de	72f	78e	80e	95c	84d	95c	82d	22h	1.040
200	I	145d	165b	124g	120gh	115I	130ef	121gh	132e	160c	180a	118h	25j	1.350
	II	138a	145a	72e	102c	94cd	98cd	92d	97cd	125b	120b	96cd	28f	2.987
250	I	162c	172a	140f	131gh	122i	133g	145e	141f	152d	167b	138f	30j	1.430
	II	142b	148a	78h	105g	102g	115e	110f	117de	134c	142b	120d	30i	0.832
300	I	168c	178a	142g	134i	129j	137h	151e	147f	156d	172b	142g	28k	0.891
	II	150c	155b	84k	112i	110j	120g	117h	121f	142d	168a	129e	31i	0.105
350	I	170b	185a	148e	137g	132h	142f	156d	152de	161c	182a	145ef	32i	1.150
	II	152c	161b	91i	118h	115hi	130fg	132f	128g	145d	172a	134e	35	0.653
400	I	172c	190a	150fg	141i	134j	147gh	162d	158de	169cd	185b	152f	35k	1.157
	II	161b	169b	98f	125d	121de	135cd	140c	132cd	155bc	189a	140c	37g	5.890
450	I	175c	192a	157e	143g	139h	152f	167d	160e	172cd	190ab	156e	40i	1.414
	II	168bc	172b	100e	132cd	129cd	138cd	145cd	141cd	158bc	194a	142cd	41f	1.568
500	I	182b	200a	161e	148f	142g	159ef	159d	162e	175c	198a	160e	41h	0.871
	II	171b	175b	110g	139e	135f	140e	157d	149e	162c	197a	151e	43h	1.860
Mean	I	144.0	158.2	123.0	11.49	108.8	119.5	129.2	127.5	139.2	157.0	122.7	26.8	
	II	133.5	141.0	79.3	98.5	94.5	104.8	107.7	108.0	122.2	141.6	108.5	28.6	

A = Six adults; B = Twelve adults; C = One male + two females + four I instar grubs; D = One male + two females; E = Four I instar grubs; F = Four II instar grubs; G = Four III instar grubs; H = Four IV instar grubs; I = Six adults + one I instar-day; J = Twelve adults + one I instar added; K = One male + two females + four I instar grubs; L = Control

* Means foulowed by similar letters in vertical columns are not different statistically (p=0.05) by D.M.R.T.

RESULTS AND DISCUSSION

Feeding preference shown by the various stages of predators for different instars of aphids are given in Table 1. Significant difference in preference for prey of various ages was evident among the predators. The first stage grubs killed preys of all instars of aphids and the total consumption was however lower compared to second stage grubs that killed and consumed the parthenogenetic females in addition. The third and fourth stage grubs consumed winged aphids and the adult predators consumed appreciable number of all the stages. Among the sexes, the female consumed more number of aphids than the male. The mean consumption of II, III and IV instar aphids by all the stages of the predator remained statistically on par in *C.transversalis*. Among the predatory grubs, the fourth instar and third instar consumed the maximum number of aphids in the case of *C.transversalis* and *C.sexmaculatus* respectively. As the grubs increased in age, they consumed older instars of aphids and the prey age preference shown by predatory grubs for the first instar aphids might be due to the fragile nature of these preys. As the grub increased in age and size, it attacked larger aphids with ease due to its increased mobility, activity and strength. Adult beetles fed on all age groups and forms of aphid, and no specific preference among the prey was seen. Saharia (1981) made similar observations in *Coccinella repanda* Feb., and no feeding

preference was shown by grown up grubs and adult predators for prey aphid groups.

The age dependent interference of the predators to prey consumption was determined by taking various combination of prey stages and allowing them to feed on known number of preys. The results presented in Table 2 showed that the various combination of adults and grubs at different levels significantly influenced the prey consumption. The treatment with 12 adult predators (B) resulted in maximum number of aphids eaten at all prey levels followed by the treatment with 12 adults + one first instar grub (J) and were statistically on par. The addition of one first instar grub in the combination did not increase the feeding rate of adults. Treatment A with six adults consumed appreciable number of aphids (144.0).

However, the juveniles showed variation between the different age groups *viz.*, I, II, III and IV instars. The first instar grup, being very small in size consumed less number of aphids compared to other stages of grubs. Hence, when the grub developed into II, III and IV instars, the developmental response operated and the predator consumed more number of aphids. Among the grubs, the third instar grub consumed the maximum mean number of aphids (129.2). The prey consumption in treatments C and F and K were statistically on par. In *C.sexmaculatus*, the prey consumption by twelve adults + one first instar grub, (J) remained highest and statistically identical.

Since, both grub and adult coccinellids feed on the same kind of prey, possible existence of interference among them while feeding was expected but the results revealed no such interference since the feeding was not affected either by the presence of grubs or adults in the feeding arena. Among the grubs, the third stage grubs consumed maximum number of aphids than the other stages. This increased feeding might be due to its increased age and capture efficiency by a process of learning as reported by Murdoch (1971) in *Notonecta hoffmanni* Hungerford. However, the fourth stage grubs consumed less number of aphids possibly due to entering prepupation. Another possible reason might be the increase in age of predatory grubs resulting in the rapidity of predator response following prey contact thereby taking less time to catch and consume more number of prey (Murdoch, 1971; Wratten, 1973).

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