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SEARCHING RATE AND INTERFERANCE VALUE OF *Chrysopa septempunctata* Wesm, AND *Crysoperla carnea* (Steph.) IN RESPONSE TO DIFFERENT APHID SPECIES

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ABSTRACT

Searching rate and mutual interference value of the two Chrysopid predators, *Chrysopa septempunctata* Wesm. and *Chrysoperla carnea* (Steph.) were evaluated in response to three species of aphids, *Aphis gossypii* Glover, *Aphis craccivora* Koch, and *Rhopalosiphum maidis* Fitch, in the laboratory.

Ch. septempunctata larvae exhibited relatively higher searching rate in comparison with *Chr. carnea* on all tested aphid preys. The searching rate for larvae of both Chrysopid predators was affected by the larval age as well as the prey species. However, the searching rate increased as the larvae grew older. In addition to both predators recorded the highest searching rate on *A. gossypii* followed by *R. maidis* and *A. cracivora*, respectively.

The regression analysis indicated that both predators exhibited lower interference value on *A. craccivora* and *R. maidis* than *A. gossypii*. *Ch. septempunctata* had a high searching rate with relatively high mutual interference in comparison with *Chr. camea*.

INTRODUCTION

The study of Chrysopid species as biological agents, against aphid pests is reviewed in the literature of various countries including Egypt. Lolivier *et al.* (1999), Badgujar *et al.* (2000), El-Defrawi *et al.* (2000), and Wittenborn and Olkowski (2000). The recent problems caused by aphids drew much attention to one of its important natural enemies *Chrysoperla carnea* (Steph.), which has been used successfully as a biological agent for the potential control of several important pests attacking field and orchard crops (Gurbanov, 1982 and Ibrahim and Afifi, 1991). *Chrysopa septempunctata* Wesm. is one of the few species among the Chryspids, whicn both its larvae and adults are predaceous. Abd El-Kareim (1998) record that *Chr. carnea* showed a higher searching rate of all the tested larval instars, at all densities than *C. undecimpunctata* L., which higher mutual interference value especially with the last instar than *Chr. carnea*.

The aim of this study was to evaluate some searching characteristics (i.e. searching rate and mutual interference) of the two Chrysopid predators, *Chr. carnea* (larvae) and *Ch. septempunctata* (including larvae and adult) in response to different prey species of aphids.

MATERIALS AND METHODS

Adults of *Chrysoperla carnea* Steph. and *Chrysopa septempunctata* Wesm. were collected from a citrus orchard, located in Mansoura University farm by using a sweeping net. The collected adults were kept in glass chimney, for egg lying, which provided with feeding sources (honey solution and aphids for *Chr. camea* and *Ch. septempunctata*, respectively). The eggs transferred singly by cutting of their stalk in glass tube until hatching.

Individuals of each species were collected from untreated host plants with insecticides located in Mansoura district. Homogenous plants were collected and artificially infested with aphids for the experiments.

To compare the searching rate (a_t) and interference value of each tested predator larvae in response to different prey species of aphids (*Aphis gossypii* Glover, *Aphis craccivora* Koch, and *Rhopalosiphum maidis* Fitch) under laboratory conditions, five densities (1, 3, 6, 7 and 9) of each predator larval instar (1^{st}, 2^{nd} and 3^{rd} instar larvae, respectively), were evaluated by confining 150 individual of each different preys with each predator density in a cylinder screen cage (10 in diameter and 30 cm length) for 24 hrs. Each predator density was replicated five times. The predated preys were counted and recorded. The searching rate (a_t) and interference value (m) of each Chrysopid larval instar were calculated in response to each prey species.

The searching rate was calculated according to Varley *et al.* (1973) as follow:

$$a_t = \frac{1}{P} \log_e \frac{N}{S}$$

Where:

P: is the number of predators,

N: is the number of preys and S is the number of unpredsceased insects.

The relationship between the search rate (a_t) and predator density (log P) are indicated by the slope of the evaluation:

$$\log_{at} = \log Q - m \log P$$

Where:

Q: is the quest value (the search rate when the predator density is one),

m: is the mutual interference value.

The study was carried out at room temperature 30±5°C and RH 70±5% during summer 1999.

The same searching characteristics of the predator adult of *Ch. septempunctata* newly emerged adult females and males was also evaluated at five prey densities 1, 3, 5, 7 and 9 in the previously mentioned plastic pots, which is provided with 150 individuals of each prey species: Each adult predator density was replicated five times.

RESULTS AND DISCUSSION

1. Searching rates:

The first instar larvae of each *Ch. septempunctata* and *Chr. carnea* showed similar searching rates at all tested densities in response to *A. cracivora* (Table 1 and 2). The third instar larvae of both Chrysopid species exhibited the higher searching rate in comparison with that of the first or second instar, especially, *Ch. septempunctata*. However, the older larvae has higher searching rate than the newly ones. The obtained data also illustrated that *Ch. septempunctata* adult females showed relatively higher searching rate in comparison with adult male (Table 1). In respect to the prey species, the searching rate for both predators was affected by prey species. *A. gossypii* proved to be the favourable prey for both tested predators, followed by *R. maidis* and *A. cracivora*, respectively (Tables 1, 2 and 3).

Table 1: The searching rates of the different larval instars and adult stage (male and female of *Ch. septempunctata* in response to different prey species, *A. gossypii*, *A. cracivora* and *R. maidis* at different predator densities (1, 3, 5, 7 and 9 individuals, respectively).

Prey Species	Predator Density	Larval instar			Adult	
		1st instar	2nd instar	3rd instar	Male	Female
	1	0.24	0.70	2.25	0.40	0.60
A. gossypii	3	0.08	0.20	0.60	0.11	0.20
	5	0.04	0.11	0.31	0.10	0.10
	7	0.02	0.08	0.02	0.03	0.10
	9	0.01	0.04	0.12	0.02	0.04
	1	0.13	0.50	1.10	0.30	0.40
A. cracivora	3	0.04	0.10	0.30	0.10	0.10
	5	0.02	0.08	0.20	0.04	0.10
	7	0.01	0.05	0.10	0.02	0.04
	9	0.01	0.03	0.10	0.02	0.03
	1	0.16	0.50	1.10	0.30	0.43
R.	3	0.05	0.20	0.35	0.10	0.12
maidis	5	0.02	0.08	0.20	0.10	0.10
	7	0.02	0.05	0.10	0.03	0.05
	9	0.01	0.03	0.10	0.03	0.03

Second instar larvae of *Ch. carnea* (Table 2) recorded approximately the same searching rate of *A. carcivora* and *R. maidis* at all predator density. Also, the 3rd instar larva of *Ch. septempunctata* exhibited the same response on both *A. cracivora* and *R. maidis*, respectively (Table 1).

Generally, the searching rate of *Chr. carnea* and *Ch. septempunctata* increased as the larvae grew older. On the other hand, the searching rate was affected by the prey species. However, both predators recorded the highest searching rate on *A. gossypii* followed by *R. maidis* and *A. craccivora*, respectively. This in agreement with Abd El-Kareim (1998) when *Chr. carnea* and *Coccinella undecimpunctata* L. reared on the cotton whitefly *Bemisia tabaci* Genn.

Table 2: The searching rates of the different larval instars of *Chr. carnea* in response to different prey species, *A. gossypii*, *A. cracivora* and *R. maidis* at different predator densities (1, 3, 5, 7 and 9 individuals, respectively).

Prey Species	Predator Density	Larval instar		
		1st instar	2nd instar	3rd instar
A. gossypii	1	0.21	0.60	1.87
	3	0.06	0.20	0.50
	5	0.03	0.10	0.25
	7	0.02	0.10	0.15
	9	0.01	0.04	0.10
A. cracivora	1	0.12	0.42	0.90
	3	0.04	0.12	0.30
	5	0.02	0.10	0.14
	7	0.01	0.04	0.11
	9	0.01	0.03	0.10
R. maidis	1	0.13	0.43	0.97
	3	0.04	0.13	0.30
	5	0.02	0.10	0.17
	7	0.01	0.04	0.15
	9	0.01	0.03	0.10

Table 3: The relationship between the search rate (a_t) and predator density (P) on to different prey species (*A. gossypii*, *A. cracivora* and *R. maidis*) for each larval instar of both predators (*Ch. septempunctata* (A) and *Chr. carnea* (B).

Larval instar	Predator	Prey species		
		A. gossypii	*A. cracivora*	*R.maidis*
1st instar larva	A	$Log_a = -0.35 - 1.60 \log P$	$Log_a = -0.83 - 1.30 \log P$	$Log_a = -0.79 - 1.19 \log P$
	B	$Log_a = -0.50 - 1.54 \log P$	$Log_a = -0.83 - 1.30 \log P$	$Log_a = -0.35 - 1.60 \log P$
2nd instar larva	A	$Log_a = -0.23 - 1.12 \log P$	$Log_a = -0.34 - 1.11 \log P$	$Log_a = -0.83 - 1.07 \log P$
	B	$Log_a = -0.35 - 1.60 \log P$	$Log_a = -0.51 - 1.89 \log P$	$Log_a = -0.51 - 1.89 \log P$
3rd instar larva	A	$Log_a = -0.22 - 1.14 \log P$	$Log_a = -0.17 - 1.29 \log P$	$Log_a = -0.17 - 1.29 \log P$
	B	$Log_a = -0.31 - 1.36 \log P$	$Log_a = -0.06 - 1.08 \log P$	$Log_a = -0.06 - 1.14 \log P$
Adult stage	Male	$Log_a = -0.17 - 1.55 \log P$	$Log_a = -0.40 - 1.51 \log P$	$Log_a = -0.41 - 1.16 \log P$
	female	$Log_a = -0.18 - 1.20 \log P$	$Log_a = -0.39 - 1.20 \log P$	$Log_a = -0.38 - 1.07 \log P$

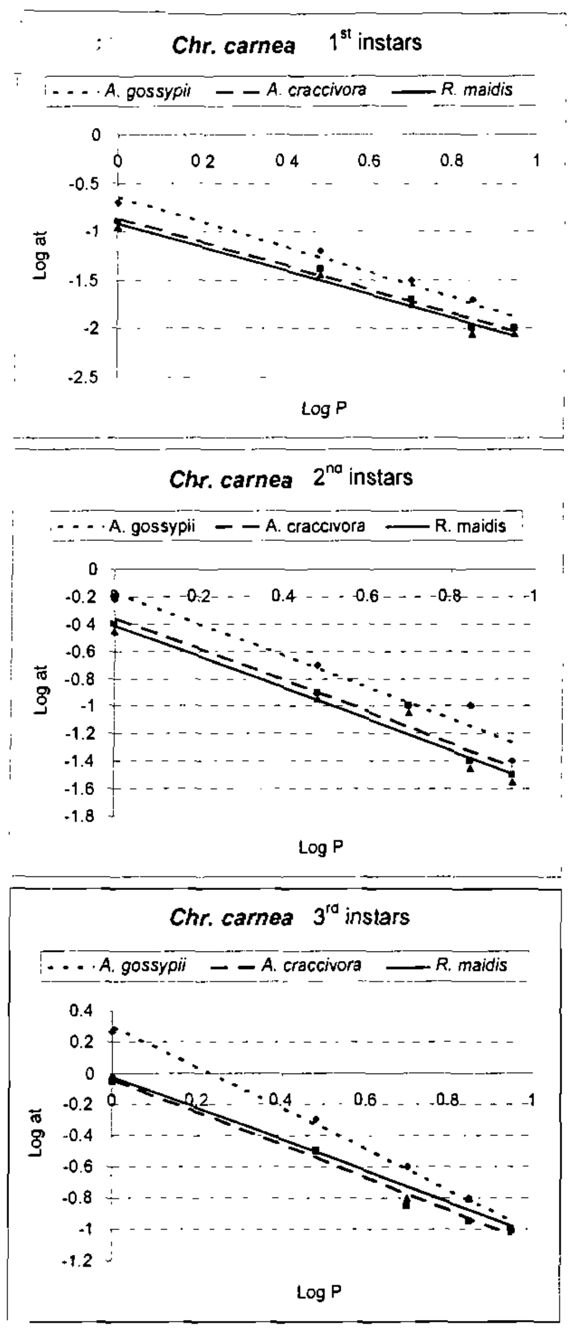
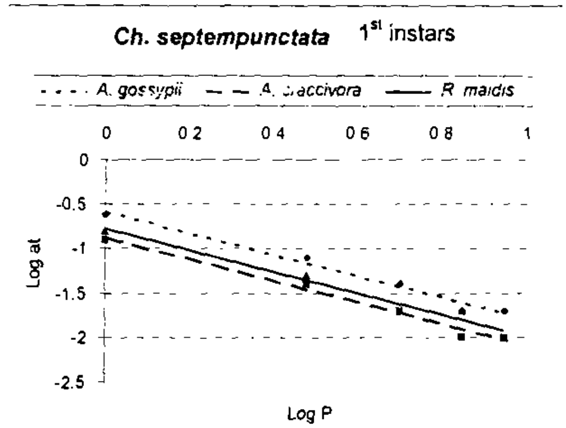
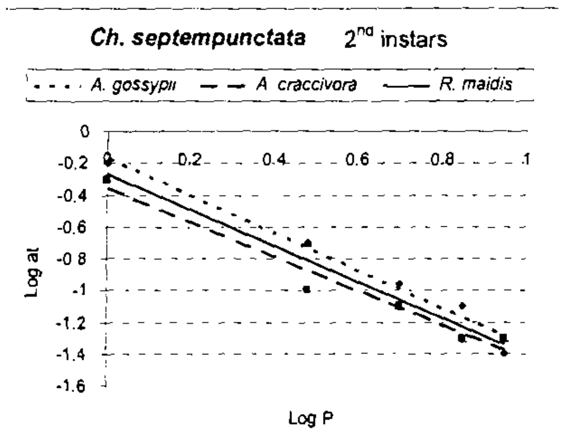
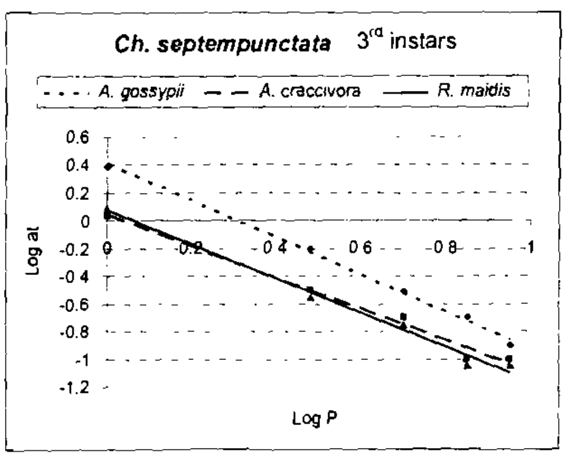


Fig. 1: The relation between predator density (Log P) and searching rate (Log_{at}) of *Chr. carnea* larvae (1st, 2nd, 3rd instars).


Ch. septempunctata 1st instars
A. gossypii
R. maidis
Log at
Log P


Ch. septempunctata 2nd instars
A. gossypii
A. craccivora
R. maidis
Log at
Log P


Ch. septempunctata 3rd instars
A. gossypii
A. craccivora
R. maidis
Log at
Log P

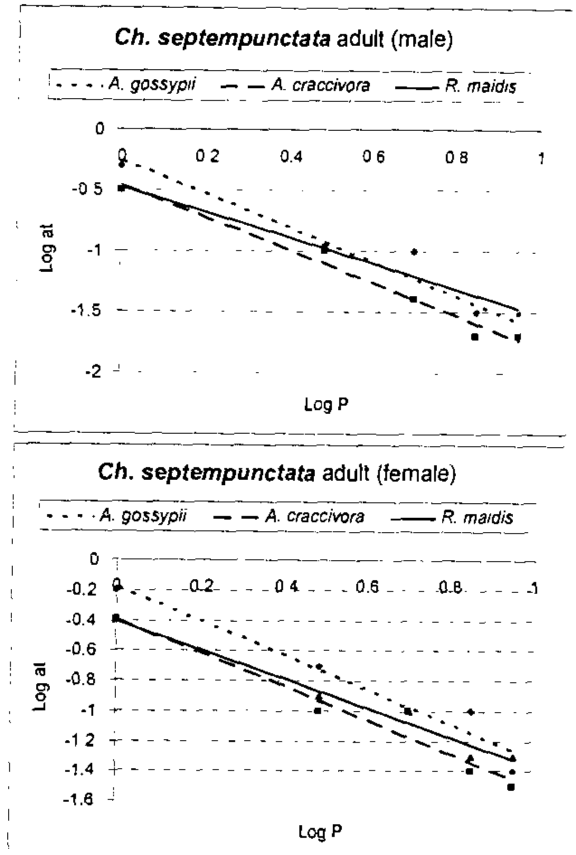


Fig. 2: The relation between predator density (Log P) and searching rate (Log_{at}) of *Ch. septempunctata* larvae (1^{st}, 2^{nd}, 3^{rd} instars) and adults (male and female).

2. Mutual interference:

As shown in Figs 1 and 2, by increasing predator density, the number of consumed preys per predator larvae was decreased specially in case of *Ch. septempunctata*. Such reduction is evidence in a reducing search rate (Rogers and Hassell, 1974).

The regression of various searching rates (a_t) on (P) of different predator density for each prey could be illustrated the relationship between the search rate and predator density.

Searching rate of both predators at different predator larval instar as well as *Ch. septempunctata* adult stage densities are illustrated in Figs 1 and 2. Searching rate of *Chr. carnea* larvae was slightly decreased as well as predator density increases in comparison with *Ch. septempunctata* (El-Arnaouty and Ferran, 1993).

As shown in Table 3 and Figs 1 & 2, the mutual interference value of both tested predators showed variable changes according to prey species. According to El-Batran and Fathy (1991), the predating efficiency of *Chr. carnea* increased as the larvae grew older. They added that the larva needs a certain amount of proteins to grow up and this amount of proteins determines the consumed number of prey. Also, Dai (1990) and Nastskova (1985) added that the rate of development varied depending on the prey species.

Both stages (larva and adult) of the predator *Ch. septempunctata* have high predation ability on the three tested aphid preys. The third larval instar comes in first rank in predation followed by the second, and first one, respectively. This finding is in agreement with the results given by Ghanim & El-Adl (1987) and El-Batran (1992, also they reported that the feeding activity of *Ch. septempunctata* was differs according to prey type.

R. maidis was the best prey as nourishment, and may offer special nutritional elements for the Chrysopid, *Parachrysopa pallens* R. in comparison with *A. gossypii* and *B. brassicae* (Abou Bakr, 1989). The present investigation indicate that both chrysopid species exhibited relatively lower interference value in response to *R. maidis*.

Ribeiro and Freitas (2000) recorded that adult food is important to reproductive potential and development changes on *Chrysopesla externa* (Hagen), that is agree with the results of the present work.

According to Varley *et al.* (1973) the higher the searching efficiency with low interference value, the lowest the averaged densities of both prey and predator populations. Therefore, both predators promise to be a good predators against aphids. However, both predators exhibited the highest searching rate in response to *A. gossypii* and the lowest interference value on *R. maidis*.

The impact of *Chr. carnea* seems very promising for the control of some aphid species (Bondarenko, 1975 and Ibrahim & Afifi, 1991).

Then, we can use predators, *Ch. septempunctata* and *Chr. carnea* as biological control agent against many species of aphids in a mass rearing and releasing program through the year in the integrated pest management program.

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معد ل البحث وقيمة التداخل لكـــل مــن *Chrysopa septempunctata* Wesm. و*Chrysoperla carnea* (Steph.) وإستجابتهما للانواع المختلفة من حشرات المن .

ليلى عبدالستار البطران .
قسم الحشرات الإقتصادية – كلية الزراعة – جامعة المنصورة .

تم دراسة معدل البحث والتداخـــل بيــن المفترســين *Chrysopa septempunctata* Wesm. و *Chrysoperla carnea* (Steph.)

والإستجابة المختلفة لثلا ث أنواع من حشرات المن فى المعمل باعتبارها أهم أنواع المن السائدة والهامـــة لإنها تصيب زراعات هامة فى البيئة المصرية وهى :

Aphis gossypii Glover و Aphis *craccivora* Koch و *Rhopalosiphum maidis* Fitch

ولقد أظهرت النتائج إلى :

- المفترس *Chrysopa septempunctata* له معدل بحثى أكثر مــــن المفـــترس *Chrysoperla carnea* وذلك فى الثلاث أنواع من حشرات المن السابقة كما أن .
- معدل البحث تأثر فى كلا المفترسين بكل من عمر اليرقات ونوع المن كفريسة .
- و من الواضح إنه كلما زادت عمر اليرقة تزداد عمليتى البحث والافتراس ولقد أظهرت النتائج أن كـــل من المفترسين السابقين يفضل حشرات من القطن ثم حشرات من الذرة وأخيرا حشرات من البقوليات .
- وأظهر البحث أن المفترس *Chrysopa septempunctata* له قدرة عالية فى البحث عن الفريســـة مقارنة بالمفترس الأخر كما أن ظاهرة ال mutual interference وواضحة جدا بالمقارنة بـــالمفترس *Chrysoperla carnea* .
- وأظهرت النتائج أيضا أن الإناث لها قـــدرة بحـــث أعلـــى مـــن الذكورفـــى المفـــترس *Chrysopa septempunctata* .

و إنه من الضرورى الإكثار من هذين المفترسين وإطلاقهما فى الوقت المناسب لمكافحة حشرات المن لمـــا لها من سلوك بحثى على الفريسة والوصول إليها, ومن المعروف أن الحشرة النافعة تزداد أهميتـــها عندمـــا يكون لها القدرة على البحث للوصول إلى الفريسة والقضاء عليها, وبذلك تتصح النتــــائج باســـتخدام هذيـــن المفترسين فى برنامج المكافحة المتاكملة لقدرتهم العالية فى البحث عن الفريسة والقضاء عليها .