SEARCHING RATE AND INTERFERENCE VALUE OF Chrysopa septempunctata Wesm. AND Crysoperla carnea (Steph.) IN RESPONSE TO DIFFERENT APHID SPECIES
El-Batran, Laila A.
Economic Entomology Dept., Fac. of Agric., Mansoura Univ.

ABSTRACT

Searching rate and mutual interference value of the two Chrysopid predators, Chrysopa septempunctata Wesm. and Crysoperla 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. craccivora, 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. carnea.

INTRODUCTION

The study of Chrysopid species as biological agents, against aphid pests is reviewed in the literature of various countries including Egypt. Lollivier et al. (1999), Badgjara et al. (2000), El-Defawi et al. (2000), and Wittenborn and Olkowski (2000). The recent problems caused by aphids drew much attention to one of its important natural enemies Crysoperla 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 Affii, 1991). Chrysopa septempunctata Wesm. is one of the few species among the Chrysopids, which both its larvae and adults are predaceous. Abd El-Kareem (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 Crysoperla 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
El-Batran, Laila A.

chimney, for egg laying, which provided with feeding sources (honey solution and aphids for Chr. carnea and Ch. septempunctata, respectively). The eggs transferred singly by cutting off 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 ($a_i$) 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 (1st, 2nd and 3rd 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 ($a_i$) and interference value ($m$) of each Chrysopod larval instar were calculated in response to each prey species.

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

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

Where:
- $P$: is the number of predators,
- $N$: is the number of preys and $S$ is the number of unpredesceded insects.

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

$$\log a_i = \log Q - m \log P$$

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 Chrysopidae species exhibited the higher searching rate in comparison with that of the first or second instar, especially, Ch. septempunctata. However, the older larvae have 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).

<table>
<thead>
<tr>
<th>Prey Species</th>
<th>Predator Density</th>
<th>1st instar</th>
<th>2nd instar</th>
<th>3rd instar</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. gossypii</td>
<td>1</td>
<td>0.24</td>
<td>0.70</td>
<td>2.25</td>
<td>0.40</td>
<td>0.60</td>
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<td></td>
<td>3</td>
<td>0.08</td>
<td>0.20</td>
<td>0.60</td>
<td>0.11</td>
<td>0.20</td>
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<td></td>
<td>5</td>
<td>0.04</td>
<td>0.11</td>
<td>0.31</td>
<td>0.10</td>
<td>0.10</td>
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<tr>
<td></td>
<td>7</td>
<td>0.02</td>
<td>0.06</td>
<td>0.02</td>
<td>0.03</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>0.01</td>
<td>0.04</td>
<td>0.12</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>A. cracivora</td>
<td>1</td>
<td>0.13</td>
<td>0.50</td>
<td>1.10</td>
<td>0.30</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.04</td>
<td>0.10</td>
<td>0.30</td>
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<td>5</td>
<td>0.02</td>
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<td></td>
<td>7</td>
<td>0.01</td>
<td>0.06</td>
<td>0.10</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>0.01</td>
<td>0.03</td>
<td>0.10</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>R. maidis</td>
<td>1</td>
<td>0.16</td>
<td>0.50</td>
<td>1.10</td>
<td>0.30</td>
<td>0.43</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.05</td>
<td>0.20</td>
<td>0.35</td>
<td>0.10</td>
<td>0.12</td>
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<td></td>
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<td>0.02</td>
<td>0.08</td>
<td>0.20</td>
<td>0.10</td>
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<tr>
<td></td>
<td>7</td>
<td>0.02</td>
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<td>0.01</td>
<td>0.03</td>
<td>0.10</td>
<td>0.03</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Second instar larvae of Ch. carnea (Table 2) recorded approximately the same searching rate of A. cracivora 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. cracivora, respectively. This in agreement with Abd El-Kareim (1998) when Chr. carnea and Coccinella undecimpunctata L. reared on the cotton whitefly Bemisia tabaci Genn.

4103
Table 2: The searching rates of the different larval instars of *Ch. 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).

<table>
<thead>
<tr>
<th>Prey Species</th>
<th>Predator Density</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; instar</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; instar</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; instar</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>A. gossypii</em></td>
<td>1</td>
<td>0.21</td>
<td>0.60</td>
<td>1.87</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.05</td>
<td>0.20</td>
<td>0.50</td>
</tr>
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<td></td>
<td>5</td>
<td>0.03</td>
<td>0.10</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>0.02</td>
<td>0.10</td>
<td>0.15</td>
</tr>
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<td></td>
<td>9</td>
<td>0.01</td>
<td>0.04</td>
<td>0.10</td>
</tr>
<tr>
<td><em>A. cracivora</em></td>
<td>1</td>
<td>0.12</td>
<td>0.42</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.04</td>
<td>0.12</td>
<td>0.30</td>
</tr>
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<td></td>
<td>5</td>
<td>0.02</td>
<td>0.10</td>
<td>0.14</td>
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<td></td>
<td>7</td>
<td>0.01</td>
<td>0.04</td>
<td>0.11</td>
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<tr>
<td></td>
<td>9</td>
<td>0.01</td>
<td>0.03</td>
<td>0.10</td>
</tr>
<tr>
<td><em>R. maidis</em></td>
<td>1</td>
<td>0.13</td>
<td>0.43</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.04</td>
<td>0.13</td>
<td>0.30</td>
</tr>
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<td></td>
<td>5</td>
<td>0.02</td>
<td>0.10</td>
<td>0.17</td>
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<td></td>
<td>7</td>
<td>0.01</td>
<td>0.04</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>0.01</td>
<td>0.03</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Table 3: The relationship between the search rate (a<sub>i</sub>) 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 *Ch. carnea* (B)).

<table>
<thead>
<tr>
<th>Larval instar</th>
<th>Predator</th>
<th>Prey species</th>
<th><em>A. gossypii</em></th>
<th><em>A. cracivora</em></th>
<th><em>R. maidis</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; instar</td>
<td>A</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.35 - 1.60 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.83 - 1.30 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.79 - 1.19 log P</td>
<td></td>
</tr>
<tr>
<td>larva B</td>
<td>B</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.50 - 1.54 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.83 - 1.30 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.35 - 1.80 log P</td>
<td></td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; instar</td>
<td>A</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.23 - 1.12 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.34 - 1.11 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.83 - 1.07 log P</td>
<td></td>
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<tr>
<td>larva B</td>
<td>B</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.35 - 1.60 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.51 - 1.89 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.51 - 1.89 log P</td>
<td></td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; instar</td>
<td>A</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.22 - 1.14 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.17 - 1.29 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.17 - 1.29 log P</td>
<td></td>
</tr>
<tr>
<td>larva B</td>
<td>B</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.31 - 1.36 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.06 - 1.06 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.06 - 1.14 log P</td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>Male</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.17 - 1.55 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.40 - 1.51 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.41 - 1.16 log P</td>
<td></td>
</tr>
<tr>
<td>stage</td>
<td>female</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.18 - 1.20 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.39 - 1.20 log P</td>
<td>Log&lt;sub&gt;a&lt;sub&gt;i&lt;/sub&gt;&lt;/sub&gt; = -0.38 - 1.07 log P</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 1: The relation between predator density (Log P) and searching rate (Log at) of Chr. carnea larvae (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> instars).
Ch. septempunctata 1\textsuperscript{st} instars

\[ \text{Log } P \]

\[
\begin{array}{c}
\text{Ch. septempunctata 2\textsuperscript{nd} instars} \\
\text{Log } P
\end{array}
\]

\[
\begin{array}{c}
\text{Ch. septempunctata 3\textsuperscript{rd} instars} \\
\text{Log } P
\end{array}
\]

4106
Fig. 2: The relation between predator density (Log P) and searching rate (Log a) of Ch. septempunctata larvae (1st, 2nd, 3rd instars) and adults (male and female).

2. Mutual interference:
As shown in Figs 1 and 2, by increasing predator density, the number of consumed prey per predator larva 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,) 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 Crt. carnea larvae was slightly decreased as well as predator density increases in comparison with Ch. septempunctata (El-Arnaouty and Ferran, 1993).
El-Batran, Laila A.

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 Chrysoperla 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 Nastusova (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 Chrysopidae, Parachrysopsa 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 Chrysopesa 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 Ch. carnea seems very promising for the control of some aphid species (Bondarenko, 1975 and Ibrahim & Affi, 1991).

Then, we can use predators, Ch. septempunctata and Ch. 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.

REFERENCES


لعدل البحث وقيمة التداخل لكل من Chrysoperla carnea (Steph.) و Chrysopa septempunctata Wesm. من حشرات العنب، لولي عبد الله البيطار.
قسم الحشرات الإقتصادية - كلية الزراعة - جامعة المنصورة.

تم دراسة معدل البحث والتفاعلات بين المفترسين Chrysoperla carnea (Steph.) و Chrysopa septempunctata Wesm. والإستجابة المختلفة لثلاثة أنواع من حشرات العنب في المعمل، باعتبارها أهم أنواع العنب السائدة والهامة. لإثبات تأثير زراعات عقتة في البيئة المصرية وهي:
Aphis gossypii Glover, Aphis craccivora Koch, Rhopalosiphum maidis.

ولقد أظهرت النتائج:

- Chrysoperla carnea - المفترس الأول في الثلاث أنواع من حشرات العنب السائدة كما أن.
- معدل البحث تأثر في كل المفترسين بقلة عمر الزراعة ونوع العنب وكمية.
- و من الواضح أن كلها زادت عمر الزراعة تزداد عمليتها في البحث والاقتراس. وندر أظهرت النتائج أن كل
- من المفترس السابقين بعض حشرات من النبات تطال البضائع وأخيرا حشرات من الأعشاب. نحن
- قدرة عالية في البحث عن العنكبوتية Chrysopa septempunctata Cuando
- أظهرت البحث أن المفترس Chrysopa septempunctata تؤثر على المفترس الآخر كما أن ظاهرة ال
- مكافحة المفترس الأول كما أن ظاهرة ال mutual interference وواضحة جدا بالمقارنة مع المفترس
- Chrysoperla carnea Chrysopa septempunctata.

- وأظهرت النتائج أيضا أن الإناث لها قدرة بحث أعلى من الذكور في المفترس
- Chrysoperla septempunctata.
- وإنها من الضروري أكثر من هذين المفترسين لإطالة مدة البحث لمقاومة حشرات العنب لعما
- لها من سلوك بهل على القرينة والوصول إليها. ومن المعروف أن العناصر القارية تزيد أهميتها عندما
- يكون لها القدرة على الوصول إلى القرينة وقضاء عليها، وذلك لتقصي التنافس باستخدام هذين
- المفترسين في برنامج المكافحة المتداخلة لتفاديهم العالية في البحث عن القرينة وقضاء عليها.

4110