POPULATION DYNAMICS OF APHIS CRACCIVORA KOCH, LIRIOMYZA TRIFOLII (BURGESS) AND THE ASSOCIATED PREDATORS ON FABA BEAN PLANTS

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ABSTRACT: Two field experiments were carried out in Qaliobia and Kafr EL-Sheikh governorates during 2014/2015 season to study the population dynamics of Aphis craccivora Koch, Liriomyza trifolii (Burgess) infesting faba bean plants and the role of the associated predators on the population changes in the tested pests. Broad bean plants were cultivated, weekly leaf samples were collected and examined in the laboratory by a dissecting stereomicroscope as well as the numbers of the three predators: Coccinella undecimpunctata L., Chrysopela carnea (Stephs), and Orius albidipennis (Reu.) were recorded. The obtained results showed that the overall relative abundance of Aphis craccivora and Liriomyza trifolii were 26 and 74 %, respectively at Kafr EL-Sheikh governorate, and were 50%, 34%, 18% for C. undecimpunctata, C. carnea, O. albidipennis, respectively. As for Qaliobia governorate the overall relative density of Aphis craccivora and Liriomyza trifolii were 48.5% and 51.5%, respectively, and were 35.5%, 37%, 30% for C. undecimpunctata, C. carnea, O. albidipennis, respectively. Results also indicated that the three predators reduced the population numbers of A. craccivora and L. trifolii by 36% and 12%, respectively. The obtained results showed that C. undecimpunctata was the most active predator against both tested pests.

Key words: Aphid, leaf miner, predators, Vicia faba, explained variance (E.V%).

INTRODUCTION
Broad Bean, Vicia faba L. is one of the most important leguminous crops that provide a major source of protein for human in Egypt (Rizk, 2011). This crop is highly susceptible to the infestation with cowpea aphid, Aphis craccivora Koch, which considered the main pest of broad bean under Egyptian climatic conditions (Mathew et al, 1971; Saleh et al, 1972; Vercambre, 1980; EL Dafrawi et al., 2000; and Ragab et al., 2002), and Liriomyza trifolii Burgess (Mohamed and Slman, 2001). The two previous mentioned serious pests are affecting in the quantitative and qualitative yield of crop causing economic damage (Lima, 1970; Weigan and Bishara, 1991).

Biological control is a main tool of integrated control programs, since it is concerned with biotic agents including parasitoids, predators and/or pathogens (Stary, 1970). Vanderycken et al. in Belgium (2011) recorded the occurrence of aphid natural enemies (Hoverflies, coccinellids and lacewings in several agro-ecosystem, corn, wheat, potato, broad bean).

The present study aims to determine the population of Aphis craccivora and Liriomyza trifolii, which attack broad bean crop in two governorates; Kafr EL-Sheikh and Qaliobia, as well as the population of three predators: Coccinella undecimpunctata, Chrysopela carnea (Steph.) and Orius albidipennis (Reu.). Which found to be associated with the two pests and their role in decreasing the population density of studied pests.

MATERIALS AND METHODS
Field experiments were conducted in a
private farm in two governorates, Kafr El-Shiekh and Qaliobia, during 2014/2015 season. About one feddan 4200 m² in each area was divided into four plots cultivated with broad bean, Vicia faba Giza 3 variety, in the first of November of 2014 to estimate the population of the most destructive pests found to affect the yield of the crop besides the most dominant predators found to be associated with the pests. Experimental plots received the usual recommended agricultural practices and were kept without any chemical control through the growing seasons.

Apical leaves of 10 plants were randomly collected for each replicate (20 leaves) to be examined the number of Aphis craccivora.

Also, samples of 20 leaves from two levels of the plant (middle and lower) parts were weekly randomly collected and put in a paper bags to be examined in the laboratory and the leaves were examined with stereomicroscope to record the number of mines of leafminer, Liriomyza trifolii.

Direct count using manual lens (5 x) for associated predators (C. undecimpunctata, C. carnea, and O. albidipennis) were carried out and 10 plants were randomly chosen for further examination.

The percentage of relative density was calculated as follows:
Relative density = No. of individual of species / No. of all individuals of all species x100

Statistical analysis, correlation partial regression test for the tested pests with their predators were estimated to find out the relation between its associated predators and the percentage of pests population (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION:
I. Kafr El-Sheikh:
1- Aphis craccivora population:
The obtained results illustrated in Figure (1) show the population fluctuation of Aphis craccivora during the period from December, 2014 to March, 2015 at Kafr El-Sheikh region. As cleared from the figure, the population density started with average number of 94 individuals/10 apical leaves recording the first peak of abundance during the 3rd week of December, 2014. While, the 2nd peak occurred on the 3rd week of January, 2015 recording 154 individual/10 apical leaves. After that, the population decreased gradually and disappear completely during February and March, 2015.

2- Liriomyza trifolii population:
As shown in Figure (1) the population density of Liriomyza trifolii recorded four peaks of abundance. The 1st two peaks were recorded during the 1st and 4th week of January, 2015 (91 and 110 individuals/20 leaves, respectively). The 3rd peak was observed during the 2nd week of February, 2015 (40 individuals/20 leaves). While, the 4th peak occurred in the 2nd week of March, 2015 (304 individuals/20 leaves). Interestingly, the highest peak was observed during the 2nd week of February.

3- Coccinella undecimpunctata:
The number of the predator began to appear on 3rd week of December, 2014 recording 11 individuals/10 plants, these numbers gradually increased giving its highest numbers of this predator synchronized with the highest peak of L. trifolii 58 individuals/10 plants in the 2nd week of March, 2015.

4- Chrysopela carnea:
Regarding to the number of counted predator on broad bean associated with the mentioned two pests (Figure 1), it is obvious that predators number ranged from 4 to 27 individuals and the considerable numbers of this predator appeared during winter months (December, January, and February).

5- Orius albidipennis:
The number of O. albidipennis was slightly low ranging from 0 to 13 individuals giving its highest number in the 4th week of January, 2015.
Population dynamics of aphis craccivora koch, liriomyza trifolii

Relative density % was counted from the total insect pests only.

Figure (1): Weekly population density of two pests and three associated predators in Kafr El sheik governorate at 2014/2015 season

Relation between the two pests and associated predators:

Data in Table (1) show the simple correlation (r) and partial regression (b) values of A. craccivora and the population of C. undecimpunctata in Kafr EL-Sheikh governorate, together with the levels of probability. The obtained results indicated that there is a negative significant correlation between the population of the pest and predator (r = -0.59) depending on the (b) values 0.34, this means that the increase of the predator may decrease the population of the pest. The simple correlation (r) values of C. carnea and O. albidipennis and the pest population recorded insignificant correlation (0.10 and –0.36).

The overall explained variance (E.V. %) of the three combined predators was 37%, this is meaning that combined effect of the three associated predators was more effective on the A. craccivora population on the broad bean plants, Vicia faba during 2014-2015 season. Similarly, the effect of C. undecimpunctata showed negative significant correlation with population (r = 0.73). The E.V. of the three predators recorded 75%, therefore, this agent played a crucial role in minimizing the L. trifolii population more than other factors.

II. Qaliobia governorate:

1-Aphis craccivora population:

Data illustrated in Figure (2) show the number of A. craccivora found to be attacking broad bean crop in Qaliobia governorate during the season of 2014/2015 besides the number of the three predators found to be associated with it. The pest began to appear during the 2nd week of December recording 62 individuals/10 apical leaves, recording four peaks, the highest peak of 90 individuals occupied in the 3rd week of January.
2- Liriomyza trifolii population:
The Legume leafminer, L. trifolii, recorded three peaks, the highest one was 93 mines occurred during the 4th week of December. The number of the pest ranged from 18-93 mines, as for the three predators found to be associated with the tested two pests, C. undecimpunctata recorded number ranged between 4 to 24 individuals. While, C. carnea and O. albidipennis recorded numbers ranged 7 to 27 and 6 to 22 individuals, respectively.

As shown in Figures (1 and 2), the relative abundance of the two tested pests and the three predators in two governorates of study revealed that leafminer was more abundant (74%) than aphid (26%) in Kafr El-Shiekh governorate. In addition, C. undecimpunctata recorded 50% followed by C. carnea (32%) and O. albidipennis (18%). On the other hand, in Qaliobia region, the pests recorded slight differences in the population density (aphid, 48.5 and leafminer, 51.5%). While, the predators recorded 33.5%, 37%, and 30% for C. undecimpunctata, C. carnea, and O. albidipennis, respectively.

Relation between the two pests and associated predators:
The data in Table (2) show that the relationship between tested predators; C. undecimpunctata, C. carnea and O. albidipennis and the infestation of aphid, A. craccivora, was a negative relationship. This means that the increase of predators decreased the levels of aphid infestations on broad bean, V. faba. The highest correlation coefficient was recorded in case of predator, C. undecimpunctata by – 0.51.

The explained variance between these natural enemies and the infestation of A. craccivora ranged between 2% and 26%. The highest explained variance was 26% in case of C. undecimpunctata suggesting that this predator more active against aphid along with slight efficacy on leafminer than other predators in this study.

On the other hand, the overall explained variance of the three tested predators (E.V. %) with the population fluctuation of A. craccivora was 36% on broad bean in Qaliobia governorate (Table 2).

As for leaf miner, L. trifolii, data in (Table 2) cleared that the correlation coefficient was positive relationship between the three tested predators and the population fluctuation of the pest except with O. albidipennis, which recorded a negative insignificant relationship being - 0.26. However, a slight explained variance was recorded with L. trifolii. The explained variance was ranged from 1% to 7%. The overall explained variance between the population densities of L. trifolii and the three previous natural enemies was 12%.

Table (1): The simple correlation(r), partial regression (b), and explained variance (E.V.%) of the relation between two pests attacking broad bean and three associated predators in Kafr El-Sheikh governorate in 2014/2015 season.

<table>
<thead>
<tr>
<th>Pest</th>
<th>Predators</th>
<th>r</th>
<th>b</th>
<th>E.V%</th>
<th>F</th>
<th>E.V%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphis craccivora</td>
<td>C. undecimpunctata</td>
<td>-0.59*</td>
<td>0.34</td>
<td>34%</td>
<td>5.22</td>
<td>37%</td>
</tr>
<tr>
<td></td>
<td>C. carnea</td>
<td>0.10</td>
<td>0.01</td>
<td>1%</td>
<td>0.111</td>
<td></td>
</tr>
<tr>
<td></td>
<td>O. albidipennis</td>
<td>-0.36</td>
<td>0.13</td>
<td>13%</td>
<td>1.46</td>
<td></td>
</tr>
<tr>
<td>Liriomyza trifolii</td>
<td>C. undecimpunctata</td>
<td>0.73*</td>
<td>0.53</td>
<td>0.53%</td>
<td>11.208</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>C. carnea</td>
<td>0.26</td>
<td>0.07</td>
<td>7%</td>
<td>0.733</td>
<td></td>
</tr>
<tr>
<td></td>
<td>O. albidipennis</td>
<td>0.19</td>
<td>0.04</td>
<td>4%</td>
<td>0.388</td>
<td></td>
</tr>
</tbody>
</table>
Population dynamics of *aphis craccivora koch*, *liriomyza trifolii*..............

Relative density % was counted from the total insect pests only.

**Figure (2):** Weekly population density of two pests and three associated predators in Qaliobia governorate at 2014/2015 season

**Table (2):** The simple correlation (*r*), partial regression (*b*), and explained variance (E.V.%) of the relation between two pests attacking broad bean and three associated predators in Qaliobia governorate in 2014/2015 season:

<table>
<thead>
<tr>
<th>Pest</th>
<th>Predators</th>
<th><em>r</em></th>
<th><em>b</em></th>
<th>E.V.%</th>
<th>F.</th>
<th>E.V.%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aphis craccivora</strong></td>
<td><em>C.undecimpunctata</em></td>
<td>-0.51*</td>
<td>0.26</td>
<td>26%</td>
<td>3.16</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>C.carnea</em></td>
<td>-0.15</td>
<td>0.02</td>
<td>2%</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>O.albidipennis</em></td>
<td>-0.29</td>
<td>0.09</td>
<td>9%</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td><strong>Liriomyza trifolii</strong></td>
<td><em>C.undecimpunctata</em></td>
<td>0.21</td>
<td>0.04</td>
<td>4%</td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>C.carnea</em></td>
<td>0.10</td>
<td>0.01</td>
<td>1%</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>O.albidipennis</em></td>
<td>-0.26</td>
<td>0.07</td>
<td>7%</td>
<td>0.67</td>
<td></td>
</tr>
</tbody>
</table>
From the previous data, it can be concluded that *C. undecimpunctata* gave a considerable and significant reduction for both *A. craccivora* and *L. trifolii* in Kafr EL-Sheikh and Qaliobia regions, and the combined of the three tested predators recording 37% and 75% for *A. craccivora* and *L. trifolii* in Kafr EL-Sheikh. Where these predators for the three tested predators in Qaliobia governorate recorded 36% and 12% for the two pests, respectively.

Thus, it is obvious from the foregoing data that *C. undecimpunctata* had strong effect in minimizing *A. craccivora* but the other two tested predators recorded slight effects for the *L. trifolii* in the two governorates, like these results must be in mined to explain the integrated control program for these pests.

REFERENCES


Population dynamics of *aphis craccivora koch*, *liriomyza trifolii* ..............

ديناميكية تعداد حشرتي من البقوليات وصانعة انفاق أوراق الفول والمفترسات
المصاحبة لهما على نبات الفول

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الملخص العربي

تم إجراء دراسة حقلية في محافظات القلوبية وكرفر الشيخ خلال موسم 2014/2015 وذلك لدراسة التنبذب في مجتمع كل من حشرتي من البقوليات وصانعة انفاق أوراق الفول وكذلك المفترسات المصاحبة لهما وذلك عن طريق جمع عينات ورقية أسبوعية (20 ورقة) من كل من مناطق النبات المختلفة ووضعت في آكياس تقلت للمعدل للفحص بواسطة البينوكلير التشريح والعدسة اليدوية وذلك لمدة 4 شهور من عام 14/2014. 

أوضح من هذه الدراسة أن الكثافة النسبية لكل من حشرة المن وصانعة انفاق في محافظة كفر الشيخ كانت 26% ، 74% لكل من الافتين على التوالي خلال فترة الدراسة. أما بالنسبة للمفترسات الثلاثة فقد سجل أبو العيد 50% ويليه اسد المن بنسبة 34% واعيريا بق الآريس 18%. وفي محافظة القلوبية كانت الفروق بين الكثافة النسبية للافتين بسيطة (48.5% لمن و51.5% لصانعة انفاق أوراق الفول) خلال فترة الدراسة.

أما عن المفترسات فقد كانت الكثافة النسبية كالتالي : 35.5% ، 37% و 30% تقريبا لأبي العيد، اسد المن وبق الآريس على التوالي. كما اوضح النتائج أن المفترس أبو العيد ذو الإحدى عشرة نقطة أعطى نسبة خفض معنوية لكل من حشرتي من البقوليات وصانعة انفاق أوراق الفول في كل من محافظة كفر الشيخ ومحافظة القلوبية.

ذلك يوضح من الدراسة تأثير الثلاث مفترسات (أبو العيد ذو الإحدى عشرة نقطة - أسد المن - بق الآريس) في الحد من تعداد الافات المختارة ، حيث سببت نسب خفض 37% ، 75% لكل من البقوليات وصانعة انفاق أوراق الفول في محافظة كفر الشيخ، بينما في محافظة القلوبية تسبب المفترس المشترك للثلاثة مفترسات معا في خفض تعداد كل من حشرتي من البقوليات وصانعة انفاق أوراق الفول بنسبة 36% ، 12% على التوالي.