

## INSECT PREDATORS ASSOCIATED WITH SCALE INSECTS AND MEALYBUGS ON NAVEL ORANGE TREES AT KAFR EL-SHEIKH AND GHARBIA GOVERNORATES

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### ABSTRACT

Studies were carried out at navel orange orchards, at Kafr El-Sheikh and Gharbia Governorates from April 1<sup>st</sup>, 2005 up to March 15<sup>th</sup>, 2007. The studies aimed to survey the arthropod predators associated with scale insects and mealybugs. The population fluctuations of these predators were monitored. Biweekly samples of arthropods were taken using a cloth bag (75 cm long) that harboured the sampled branch of a tree. The identified predators were six coccinlids; *Chilocorus bipustulatus* L., *Exochomus flavipes* Thumberg, *Rodalia cardinalis* Mulsant, *Nephus includens* Kirsch, (= *Scymnus includens*) *Scymnus pallidivestis* Mulsant, *S. syriacus* Marseal; as well as one chrysopid, *Chrysoperla carnea* Steph. and the true spider, *Cheiracanthium jovium* Denis. At both locations, the most occurring predators were *C. bipustulatus* and *Scymnus* spp., while the lowest one was *Exochomus flavipes*, which peaked on May 1<sup>st</sup>, June 1<sup>st</sup> and October 15<sup>th</sup>, while *Scymnus* spp. peaked on mid-April and mid-September. Three peaks were recorded for *R. cardinalis* at early May, mid-September and mid-December.

**Keywords:** Arthropod, predators, scale insects, mealybugs, navel orange, kafr El-Sheikh, Gharbia.

### INTRODUCTION

Orange production accounts for more than half the total fruit production in Egypt with navel orange being the predominant variety, representing about 70% of total Egypt's orange production. Citrus is a major export product of Egypt, as the country ranks ninth in the international trade. Exports of orange in 2009/10 amounted 800,000 tones, which is equivalent to about 440 million dollars (Guvén and Sherif, 2010).

Citrus trees are frequently infested by scale insects and mealy bugs which cause considerable damage despite heavy use of insecticides. Insect predators were reported to be promising in managing citrus insects (Tawfik *et al.* 1970 and El-Agamy *et al.* 1994). The most important predators of scale insect and mealybug species, reported in Egypt, are *Chilocorus bipustulatus* L., *Exochomus flavipes* Thumberg, *Scymnus syriacus* Marseul, *S. pallidivestis* Mulsant, *Rodalia cardinalis* Mulsant (Coleoptera: Coccinellidae) and *Chrysoperla carnea* Steph. (Chrysopidae: Neuroptera) (Priesner and Hosny 1940; El-Kiey, 1964; Tawfik *et al.* 1970; Abd El-Rahman, 1981; Abd Allah, 1988; Hamed 1969, Hendawy, 1999; Sallam, 2002 and Abd Rabou and Badry, 2005). In some countries, *Nephus includens* was recorded as a

predator feeding upon mealybugs which attack citrus trees (Yigit *et al*, 1994; Canhilal *et al*, 2001 and Kontodimas *et al*, 2007).

The present work was conducted on naval orange orchards at Kafr El-Sheikh and Gharbia Governorates to enhance knowledge on citrus scale insects, mealybugs, and their associated predators. Relying on these knowledge, integrated insect pest programs could be designed.

## **MATERIALS AND METHODS**

### **1. Experimental sites:**

The current studies were carried out on navel orange trees at Gharbia and Kafr El-Sheikh governorates. Gharbia was represented by an orchard located at Shubra El-Namla village, about 15 km west of Tanta, and at El-Menchat Al-Kobra, about 15 km north of Kafr El-Sheikh. The experimental period extended for two seasons; beginning from April 1<sup>st</sup>, 2005 up to March 15<sup>th</sup>, 2007. Citrus orchards, from which the samples were taken, were insecticide-free throughout the experimental period.

### **2. Sampling of predators:**

The insect predators and spiders associated with scale insects and mealybugs were surveyed. Biweekly samples were taken from five trees assigned for this investigation.

When sampling, the arthropods occurring on five branches per tree were obtained by introducing the branch into a white cloth bag (75 cm long). Upon shaking the branch, arthropods were dislodged inside the cloth bag. The predators were collected from 25 branches/ location/ sample. The cloth bag was tightly closed, transferred to the laboratory at Sakha Agricultural Research Station and kept in the refrigerator to immobilize the confined arthropods. Fifteen minutes later, the bag was taken out from the refrigerator and emptied onto white paper sheet to examine and count the insect predators and spiders. Afterwards, specimens were kept into glass vials with 70 % ethyl alcohol. The specimens were sent to the systematic laboratory at Plant Protection Research Institute, Agricultural Research Center for identification.

## **RESULTS AND DISCUSSION**

### **Survey:**

Predators associated with citrus insect pests were surveyed on citrus trees at Kafr El-Sheikh and Gharbia Governorates. Eight predatory species, belonging to two classes, three families and three orders were surveyed. Six predatory species, related to Coleoptera (6 coccinellids), Neuroptera (one chrysopid) and true spider (one miturgid) were identified.

**Population density:**

**At Kafr El-Sheikh Governorate:**

Total collected numbers of insect predators from 600 branches (24 examinations x 25 branch each) of citrus trees were 1231 and 1288 individuals in 2005/06 and 2006/07 seasons, respectively (Table 1).

**Table (1): Population density of insect predators associated with insect pests attacking navel orange trees insect pests at Kafr Sheikh and Gharbia Governorates.**

Insect species	Stage	2005/06 season		2006/07 season	
		No./600 branches	%	No./600 branches	%
<b>Kafr El-Sheikh</b>					
<i>Chilocorus bipustulatus</i>	Larva&Adult	374	30.38	387	30.05
<i>Scymnus</i> spp. & <i>Nephus includens</i>	Adult	332	26.97	350	27.17
<i>Rodalia cardinalis</i>	Adult	238	19.33	285	22.13
<i>Chrysoperla carnea</i>	Larvae	219	17.79	214	16.61
<i>Exochomus flavipes</i>	Adult	68	5.52	52	4.04
<b>Taotal</b>		<b>1231</b>		<b>1288</b>	
<b>Gharbia</b>					
<i>Chilocorus bipustulatus</i>	Larva&Adult	311	29.62	320	29.20
<i>Scymnus</i> spp. & <i>Nephus includens</i>	Adult	286	27.24	291	26.55
<i>Rodalia cardinalis</i>	Adult	221	21.05	269	24.54
<i>Chrysoperla carnea</i>	Larvae	187	17.81	183	16.70
<i>Exochomus flavipes</i>	Adult	45	4.29	33	3.01
<b>Taotal</b>		<b>1050</b>		<b>1096</b>	

In the first season, the highest total population density was that of *C. bipustulatus*, being 374 larvae and adults/600 citrus branches, followed by *Scymnus* spp. and *N. includens* with 332 adults, *Rodalia cardinalis* with 238 adults, *Chrysoperla carnea* with 219 larvae, and *Exochomus flavipes*, with 68 adults per 600 citrus branches. Thus, the highest percentage represented predator was *Chilocorus bipustulatus* (30.38 % out of total predatory individuals), while the lowest percentage represented one was *E. flavipes* (5.52%).

In the second season, a similar trend was obtained. The population densities of *C. bipustulatus* and *Scymnus* spp. and *N. includens* were the highest ones (30.05 and 27.17 %, respectively), but *R. cardinalis* came third (22.13 %). The remaining insect predators took exactly the same order of the first season, with *E. flavipes* being, also, the lowest represented predator (4.04 % out of total).

**At Gharbia Governorate:**

The total numbers of collected insect predators were 1050 and 1096 individuals per 600 citrus branches in the first and second seasons, respectively (Table 1). The most occurring predator was *C. bipustulatus*, being 29.62 and 29.20 % out of total, in the first and second seasons, respectively. The second rank of occurrence was occupied by *Scymnus* spp. and *N. includens* with 27.24 and 26.55 % in the two seasons, respectively. Similar to the population densities of the predators calculated at Kafr El-Sheikh Governorate, the lowest densities, in both seasons, were those of *E. flavipes* (4.29 and 3.01 out of total, respectively).

*Exochomus flavipes* was previously reported as a predator to *Chrysomphalus ficus* by Priesner and Hosny (1940) and El-Keiy (1964), Azab *et al* (1968), Tawfik *et al* (1970) and Hamed and Hassanein (1991). *Chilocorus bipustulatus* was found to prey upon *Chrysomphalus ficus* (El-Keiy, 1964) and other scale insects (Hamed and Hassanein, 1991). Scale insects were also preyed upon by *Nephus (Scymnus) includens* (El-Keiy, 1964) and Abdel-Salam *et al* 2010, *Scymnus syriaccus* (Hamed and Hassanein, 1991).

**Population fluctuations:**

**At Kafr El-Sheikh Governorate:**

***Chilocorus bipustulatus***

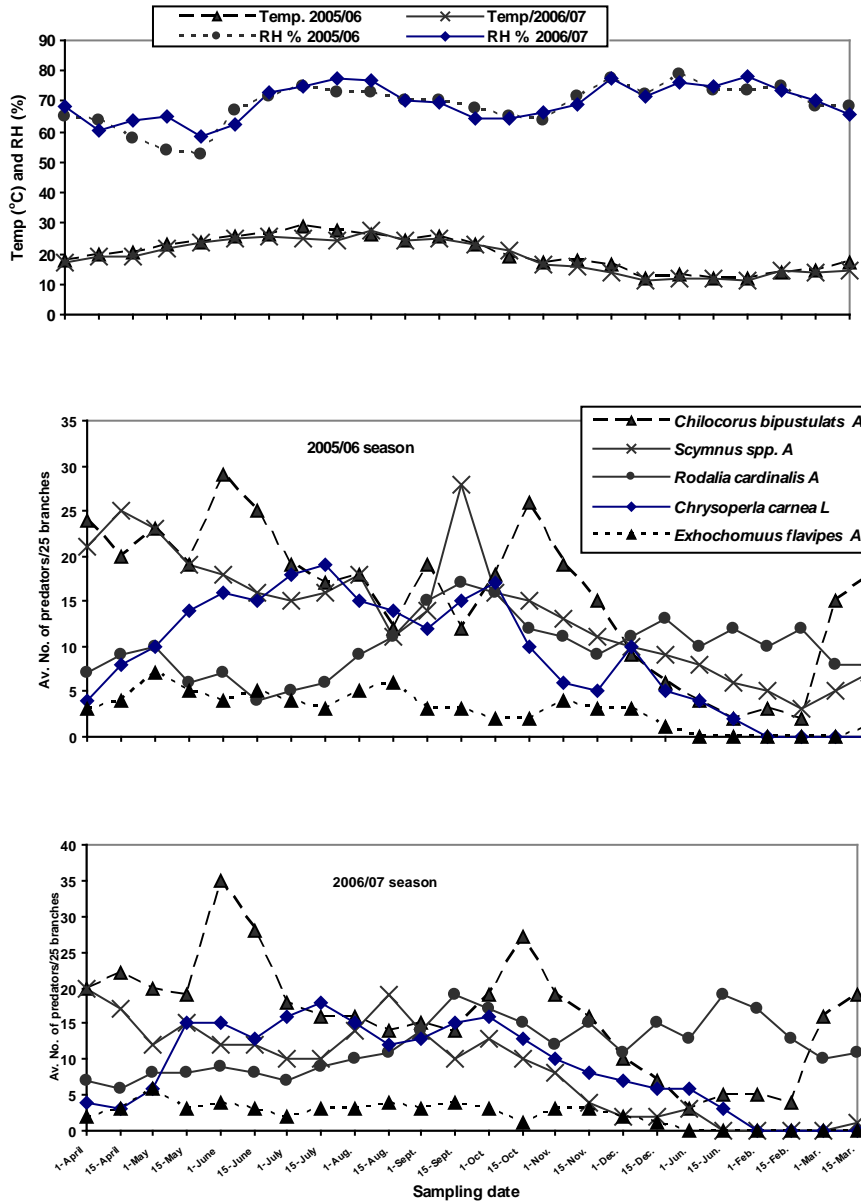
*Chilocorus bipustulatus* adults exhibited three and two peaks of occurrence in 2005/06 and 2006/07 seasons, respectively. In the first season (Fig. 1), the peaks were detected on May 1<sup>st</sup>, June 1<sup>st</sup> and October 15<sup>th</sup> with densities of 23, 29 and 26 larvae and adults/25 citrus branches, respectively. The average temperature during these peaks ranged 19.33-23.90 °C. The insect population was obviously low during December, January and February which coincided with the lowest average temperature, ranging between 11.53 and 16.10 °C. In the second season (Fig. 1), the predator larvae and adults appeared in two peaks; on June 1<sup>st</sup> at 23.70 °C with 35 individuals per 25 branches, and on October 15<sup>th</sup> at 20.75 °C with 27 individuals. Also, the lowest insect predator density was obtained from December 1<sup>st</sup> through February 15<sup>th</sup>, coinciding with average temperature of 11.35-14.25 °C.

***Scymnus* spp.**

In 2005/06 season (Fig. 1), two peaks of *Scymnus* spp. adults were detected; on April 15<sup>th</sup>, at average temperature of 19.50 °C, with 25 individuals/25 citrus branches, and on September 15<sup>th</sup> at 25.55 °C with 28 individuals. Three peaks were recorded in 2006/07 season (Fig. 1), with densities of 17, 19 and 13 adults/25 branches on April 15<sup>th</sup>, August 15<sup>th</sup> and October 1<sup>st</sup>, respectively. These peaks occurred at a range of temperature of 19.10-27.30 °C. In both seasons, the lowest *Scymnus* spp. population densities were observed during January, February and March.

***Rodalia cardinalis*:**

Three and two peaks of occurrence of *R. cardinalis* adults were recorded in the first and second seasons, respectively. In 2005/06 season (Fig. 1), the peaks were recorded on May 1<sup>st</sup>, September 15<sup>th</sup> and December 15<sup>th</sup> with 10, 17 and 13 adults/25 branches, respectively. The highest peak (on September 15<sup>th</sup>) coincided with 25.55 °C, while the lowest one (on December 15<sup>th</sup>) coincided with 11.53 °C. In 2006/07 season (Fig. 1), two peaks (19 adults each) occurred on September 15<sup>th</sup>, and on January 15<sup>th</sup>, at 24.90 and 11.75 °C, respectively. In both seasons, *R. cardinalis* population densities were clearly low from the first of April up to the first of July.



**Fig. (1): Population fluctuation of insect predators on navel orange trees at Kafr El-Sheikh Governorate during 2005/06 and 2006/07 seasons.**

***Chrysoperla carnea*:**

In both seasons of investigation, larval population of *C. carnea* was very low, or not being dateable, during January, February and March. In

2005/06 season (Fig. 1), the predator density was relatively high from May 15<sup>th</sup> up to September 15<sup>th</sup>. Four peaks of larvae occurred on June 1<sup>st</sup> (16 larvae/25 branches), July 15<sup>th</sup> (19 larvae), October 1<sup>st</sup> (17 larvae) and December 1<sup>st</sup> (10 larvae). In 2006/07 season (Fig. 1), three peaks of larval populations were recorded on May 15<sup>th</sup>, July 15<sup>th</sup> and October 1<sup>st</sup> with 15, 18 and 16 larvae/600 navel orange branches, respectively.

***Exochomus flavipes:***

Adults of *E. flavipes* were very few in both seasons, and they were not collected from January 1<sup>st</sup> up to March 1<sup>st</sup> in the first season and from January 1<sup>st</sup> up to March 15<sup>th</sup> in the second one (Fig. 1). However, two small peaks were recorded in the first season; on May 1<sup>st</sup> and August 15<sup>th</sup> with 7 and 6 adults/25 branches, at 20.50 and 26.03 °C., respectively. In the second season, only one peak was recorded on May 1<sup>st</sup> with six adults at 19.20 °C.

**At Gharbia Governorate:**

***Chilocorus bipustulatus:***

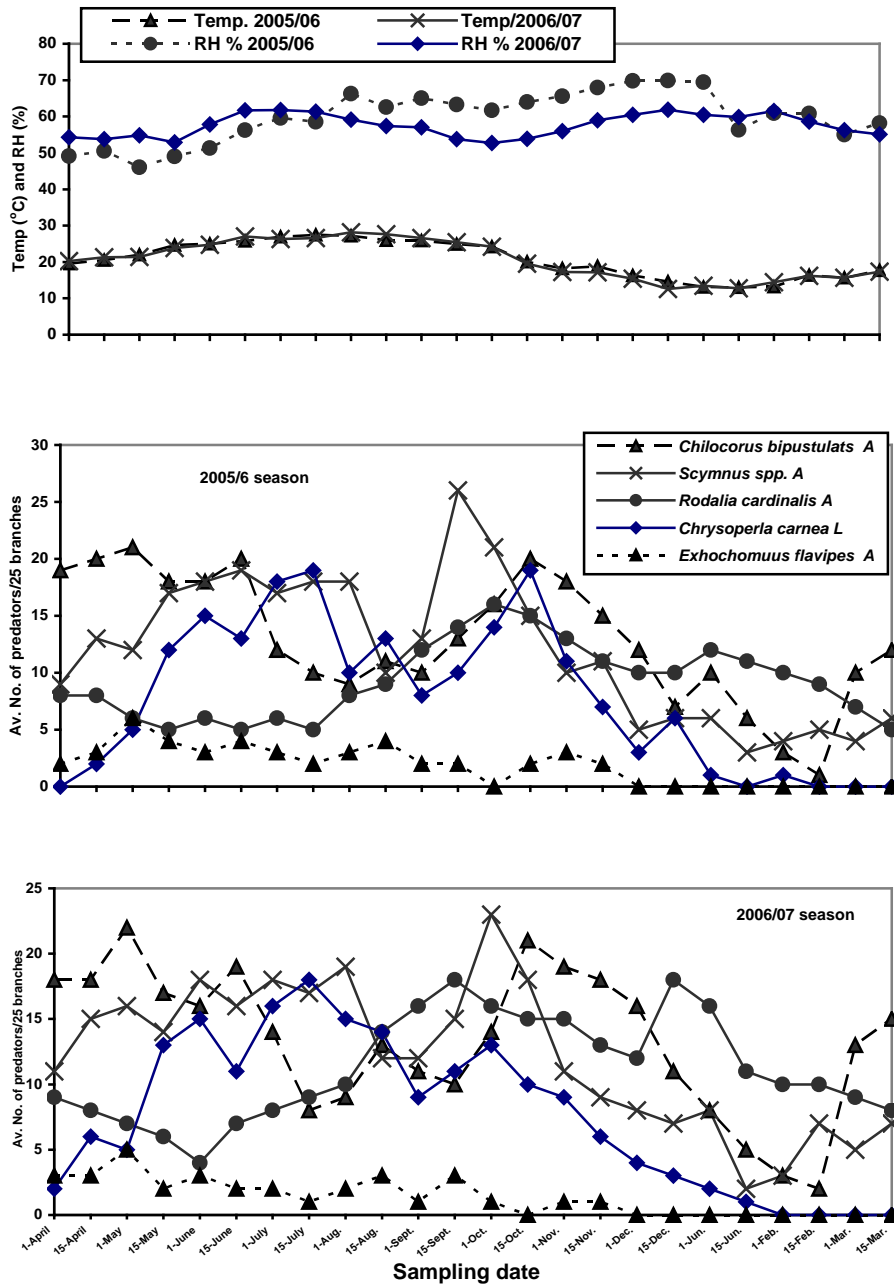
In the first season (Fig. 2), four peaks of *C. bipustulatus* larvae and adults were detected on May 7<sup>th</sup>, June 22<sup>nd</sup>, October 22<sup>nd</sup>, and January 7<sup>th</sup>, with population densities of 21, 20, 20 and 10 individuals per 25 branches, respectively. These peaks occurred with average temperatures of 22.00, 25.80, 20.03 and 13.11 °C, respectively. The larvae and adults of *C. bipustulatus* were very low during February collections. In the second season (Fig. 2), the predator exhibited three peaks of larvae and adults occurrence. The peaks were represented by 22, 19 and 21 individuals per 25 branches on May 7<sup>th</sup>, June 22<sup>nd</sup> and October 22<sup>nd</sup>, respectively. The corresponding average temperature were 21.38, 26.99 and 19.50 °C. Like the first season, the predator individuals were clearly low during February.

***Scymnus spp.:***

In the first season (Fig. 2), three peaks of *Scymnus* spp. adults were found. They were recorded on June 22<sup>nd</sup>, August 7<sup>th</sup> and September 22<sup>nd</sup>, with population densities of 19, 18 and 26 adults/25 branches, respectively. The average temperature synchronizing with these peaks were 25.80, 27.20 and 24.90 °C. In the second season (Fig. 2), only two peaks of *Scymnus* spp. adults were recorded; on August 7<sup>th</sup> (19 individuals/25 branches) at 28.18°C, and on October 7<sup>th</sup> (23 individuals) at 24.18°C. In both seasons, the numbers of the predator were obviously low during February and March.

***Rodalia cardinalis:***

The adults of this predator exhibited two peaks of occurrence in each season (Fig. 2). In the first one, the peaks appeared on October 7<sup>th</sup> (16 adults/25 citrus branches) and on January 7<sup>th</sup> (12 adults), synchronizing with 24.20 and 13.11°C, respectively. In the second season (Fig. 2), the peaks appeared on September 22<sup>nd</sup> (18 adults) and on December 22<sup>nd</sup> (18 adults) at 25.40 and 12.55°C, respectively.



**Fig. (2):** Population fluctuation of insect predators on navel orange trees at Gharbia Governorate during 2005/06 and 2006/07 seasons.

***Chrysoperla carnea:***

The larvae of this chrysopid were not detected, or rarely recorded, in both seasons during January, February and March. In the first season (Fig. 2), two peaks of larval occurrence were recorded on July 22<sup>nd</sup> (19 larvae) and on October 22<sup>nd</sup> (19 larvae) at 27.50 and 20.03 °C, respectively. In the second season (Fig. 2), three peaks were recorded; on June 7<sup>th</sup>, July 22<sup>nd</sup> and October 7<sup>th</sup> with 15, 18 and 13 larvae, respectively. The average temperature synchronizing with these peaks were 24.70, 26.56 and 24.18 °C, respectively.

***Exochomus flavipes:***

Adults of *E. flavipes* were few throughout the two seasons of study. One small peak was recorded in each season, 6 and 5 adults in the first and second seasons (Fig. 2), respectively with average temperature of 22.00 and 21.38 °C, each on May 7<sup>th</sup>.

Several investigators have surveyed the insect predators associated with citrus scale insects. Priesner and Hosny (1940) and El-Keiy (1964) observed that *Exochomus flavipes* is preying upon different stages of *Chrysomphalus ficus*. *Rodalia cardinlals* was detected in moderate numbers on citrus orchard (Tawfik *et al.*, 1970).

Rao *et al.*, (1984) recorded *Chrysopa scelestes* as a predator feeding upon eggs and nymphs of the mealy bug, *Maconellicoccus hirsutus*. Khalaf (1987) emphasized the importance of *Rodalia cardinalis* as a predator of *Icerya purchasi*. Michelakis and Hamid (1995) concluded that release of *Cryptolaemus montrouzieri* against *Planococcus citri* in citrus orchards at a rate of 1:15 significantly reduced the pest population.

Rosen (1990) considered that scale insects could be efficiently managed by insect predators due to scale insects sedentary habits, colonial distribution and relative population stability. In Turkey, Erler and Tunc (2001) reported that *Chilocorus bipustulatus* as one of the most common predators associated with diaspids. This predator achieved 2-24 % reduction in *Lepidosaphes ulmi* (Linnaeus) population in an apple orchard.

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### المفترسات الحشرية المرتبطة بالحشرات القشرية والبق الدقيقي على أشجار

### البرتقال أبو صرة بمحافظة كفر الشيخ والغربية

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أجريت هذه الدراسة ببساتين البرتقال أبو صرة بمحافظة الغربية وكفر الشيخ وذلك في الفترة من أول أبريل 2005 وحتى منتصف مارس 2007. تستهدف هذه الدراسة إلى حصر المفترسات من مفصليات الأرجل المرتبطة بالحشرات القشرية و البق الدقيقي على أشجار البرتقال أبو صرة وكذلك تذبذبات التعداد لهذه المفترسات قد سجلت حيث تم أخذ عينات كل أسبوعين وذلك بإدخال فرع الشجرة داخل كيس قماش (الطول 75سم) والحصول على المفترسات المصاحبة له.

تم تعريف أنواع من عائلة أبو العيد (رتبة غمدية الأجنحة) وهي *Chilocorus bipustulatus* L., *Exochomus flavipes* Thumberg, *Rodalia cardinalis* Mulsant, *Nephus includens* Kirsch, (= *Scymnus includens*) *Scymnus pallidivestis* Mulsant, *S. syriacus* Marseal ونوع واحد من رتبة شبيكية الأجنحة *Chrysoperla carnea* Steph وأحد أنواع العناكب *Cheiracanthium jovium* Denis.

في كل من موقعي الدراسة كان المفترسان *Chilocorus bipustulatus* و *Scymnus spp.* هما الأكثر تواجداً، بينما كان أقلهما تواجداً هو المفترس *Exochomus flavipes*. سجلت ذروة تعداد *C. bipustulatus* في الأول من مايو والأول من يونيو ومنتصف أكتوبر، بينما سجلت ذروة تعداد *Scymnus spp.* في منتصف إبريل ومنتصف سبتمبر. كما سجلت ذروة تعداد *Rodalia cardinalis* في بداية مايو، ثم منتصف سبتمبر ومنتف ديسمبر.

### قام بتحكيم البحث

كلية الزراعة - جامعة المنصورة  
مركز البحوث الزراعية

أ.د / هاله احمد كامل احمد الصيرفي  
أ.د / محمود رمزي شريف