J. Agric. Sci. Mansoura Univ., 27 (2): 1254 - 1264, 2002

STUDIES ON PREDATORY INSECTS ATTACKING PURPLE AND FLORIDA RED SCALES ON ORANGE TREES.

Abd-Allah, Laila A.; A.I. Abd El-Kareim, H.M. Fathy and S.A. Moustafa
Econ. Entomol. Dept., Fac. of Agric., Mansoura Univ.

ABSTRACT

The efficiency of predator insects of the diaspidid species, *Lepidosaphes beckii* New and *Chrysomphalus aonidum* populations (Linn.) was evaluated on orange trees during the two successive seasons 1996/1997 and 1997/1998.

During the course of study, five predators were found associated with the purple scale, *L. beckii* and Florida red scale, *Ch. aonidum* populations on the infested orange leaves. *Chilocorus bipustulatus* was the main dominant predator, it had two peaks of abundance on May and October, while the other predators showed two peaks of abundance in spring and autumn in both years of study.

Predators attacking *L. beckii* recorded three periods of activity annually in spring, summer and autumn, respectively. The lowest activity period was in winter. The percentage of predation all over the year was 9.5±3.6 and 10.6±4.0% for the first and second year, respectively. Meanwhile, it showed two periods of activity on *C. aonidum* during spring and autumn. The percentage of predation all over the year was 9.3±3.0 and 9.4±3.5% for the first and second year, respectively.

Ch. bipustulatus adults showing relatively higher searching rate in comparison with *C. undecimpunctata* under laboratory and field conditions. In addition to *C. undecimpunctata* exhibited relatively higher matual interference values than *Ch. bipustulatus*.

INTRODUCTION

The predaceous insects associated with the citrus black scale was studied by Tawfik *et al.* (1970). *Scymnus syriacus* Mrs. was always present in low number and was collected from several localities in Egypt. The larvae of *Chr. carnea* were fed on crawlers of *C. aonidum* in the field. Larvae were generally found in low numbers, but increased in July, August and September in El-Bagour and Kafr El-Sheikh districts. They added that *C. bipustulatus* and *R. cardinalis* were observed in citrus orchards especially during summer months.

The predators *Chilocorus distigma* and *Chrysopidae* were unable to control the *C. anoidum* (Cilliers, 1971), who also added that in a few cases perdition went as high as 22%, but generally fluctuated between 0-10%.

A study of the scale insects and their predators in Florida was carried out by Simanton (1977). He found that *L. beckii* and *C. aonidum* were the most dominant species. The Neuroptera and Coccinellids (especially *Chrysopa spp.* and *Chilocorus stigma* Say) were the most important predators on scale insects in citrus groves.

A survey on the predators of the arthropod pests on citrus was carried out by Soylu and Ürel (1977) in 12 orchards in different localities of the

Mediterranean region of Turkey. *Scymnus spp.* and *C. bipustulatus* are among the main important predaceous species.

Abd El-Kareim (1992) in Egypt, recorded four predaceous species on the infested orange leaves with *L. beckii*, namely, *C. undecimpunctata septempunctata, Paedereus alferii* (Koch) and *Chr. carnea*. Predator destroyed a higher proportion of the first instar than of the second the adult female of *L. beckii*.

So, the present study is based on field experiment in the Faculty of Agriculture at Mansoura region for the following objectives:-

- Surveying the predators and parasitoids associated with its host pests, *Phyllocinstis citrella*.
- Studying the population fluctuations of the above mentioned natural enemies.

MATERIALS AND METHODS

1. Survey and influence of insect predators on scale insects population:

The experiments were conducted in a neglected (Without chemical treatment) citrus orchard located at the Experimental Farm, Faculty of Agriculture, Mansoura University.

Sampling Program:

Five orange trees infested with purple and Florida red scales and homogenous in size and age were selected and marked for the present study. Samples were collected biweekly during two successive years from the 4th of March 1996 till the 16th of February, 1998. Each sample consisted of 50 infested leaves (10 leaves / tree) collected from different sides (north, south, east, west and middle) of the trees, leaves were covered with polyethylene bag on the tree and than it was puled up well tied and taken to the laboratory for examination,

To estimate the seasonal abundance of insect predators associated with orange citrus trees, four double strokes of a sweeping net of a regular size were carried out in each of the four cardinal directions of the chosen trees of orange, so that each sample was represented by sixteen double stroks for each tree.

The catch of each direction for each tree was transferred to a plastic bag containing a piece of cotton saturated with ether for anethesizing the collected insects. The plastic bags were well tied by a rubber band and were taken to the laboratory for identification, and conuting.

Estimate the effectiveness of natural enemies:

Leaves of each tree were investigated on both surfaces using a binocular microscope. Scale (purple or Florida red scales) instars were recorded as living, dead, and predated.

The presence of predators on the collected orange leaves was also recorded Meanwhile. *L.. beckii* and *C. aonidum* were attacked by predators in the field which were observed feeding on their different immature stages. The latter were collected by an aspirator.

2. Evaluation of the searching rate of *CH. bipustulatus* and *C. undecimpunctata*:

2.1. Under field conditions:

To determine the searching rate of both tested predators in the field, orange leaves were selected and marked on the trees. The marked leaves were artificially infested with crawlers of L.. beckii. The total number of settled crawlers recorded and caged by using cylinder screen-cages (10 cm in diameter x 30 cm length) Each cage continued 200 individuals. Five predator densities namely 1, 2, 4, 6 and 8 were examined by confining 200 preys with each predator density in the cylinder cage for 24 hr. Each predator density was replicated five times.

The searching rate was calculated according to Rogers and Hasseil (1974) as follow:

$$a = \frac{1}{P} \text{ Log } \frac{N}{S}$$

Where, P: the number of predators, N: the number of preys and S: the number of unpredeceased scales:

2.2. Under laboratory conditions:

To compare the searching rate of both tested predators in the laboratory, for predator densities namely 1, 3, 5 and 7 were examined by confining 100 individuals of C. *aonidum* white cape stage with each predator density in Petri-dish (15 cm in diameter) for a day Each predator density was replicated five times. The searching rate was calculated according to the same equation.

RESULTS

Predator insects associated with the purple and Elorida red scales:

1. Survey:

During the course of this study, five main predators were found associated with *L. beckii* and *C. aonidum* populations on the infested leaves. They are *Chilocorus bipustulatusL.*, *Coccinella undecimpunctata* L., Cydonia vicina isis *Gr.*, *Rodalia cardinalis* (Muls), *Chrysoperla carnea* Steph. In addition to six predators were recorded rarely in few numbers on the infested orange leaves, namely *Scymnus syriacas* Mars. and *Cydonia vicina nilotica* Muls, *C. septempunctata L.*, *Orius sp.*, *Exochomous flavipes* (Thnb) and paederus alferii Koch.

Ch. Bipustulatus was the main dominant predator associated with citrus leaves infested with the purple and Florida red scales. It was present in considerable numbers and both larvae and adults were observed feeding on different stages of *L. backii or C. aonidium* in the infested citrus orchards.

2. Seasonal abundance:

The average number of insect predators in each sample of leaves is illustrated in Fig. I. In addition to the number of each predator species collected by the sweeping net (80 double strokes) was recorded and illustrated as shown in Figures 1 and 2.

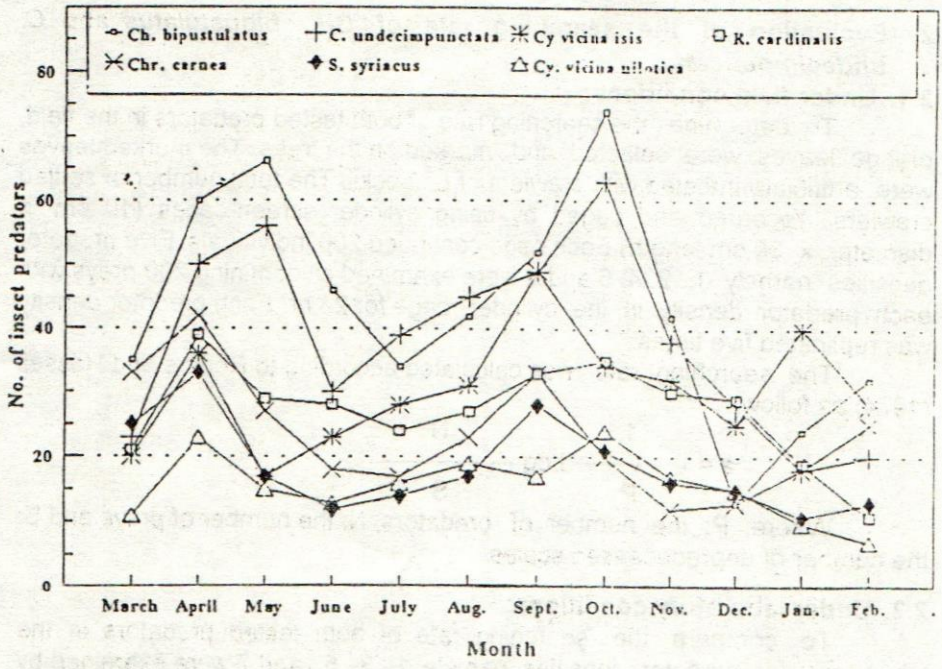

Fig 1: Seasonal abundance of insect predators associated with infested orange trees in Mansoura region during 1996/97 (No. of insects/80 double strockes)

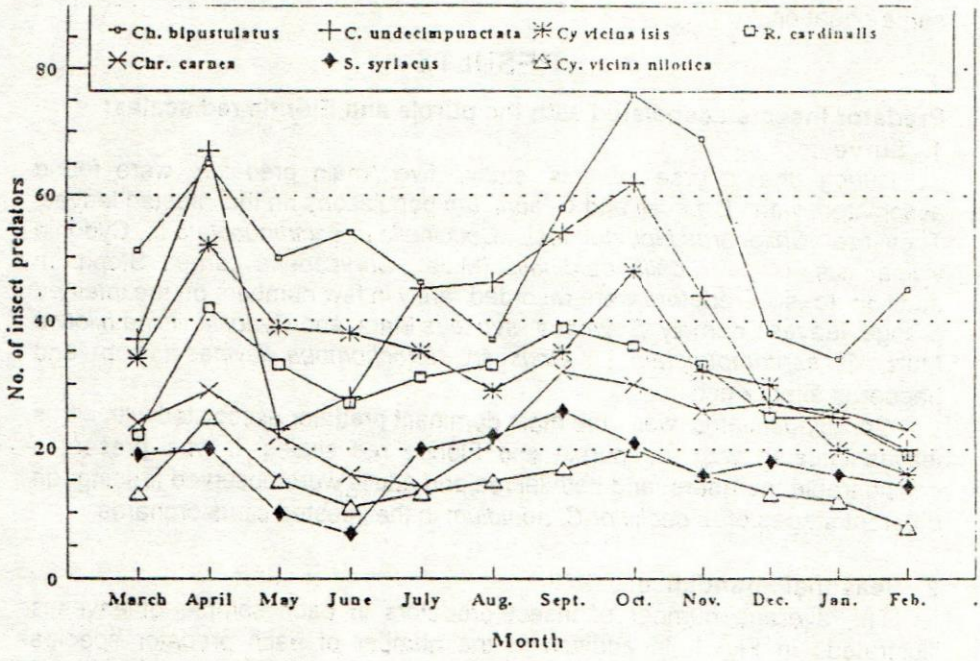

Fig 2: Seasonal abundance of insect predators associated with infested orange trees in Mansoura region during 1997/98 (No. of insects/80 double strockes)

Ch. Bipustulatus: The data shown in Figures 1 and 2, approved that *Ch. Bipustulatus* appear to be the main dominant predator.

In the first year (Fig. 1): the population changes of *Ch. Bipustulatus* exhibited the same trend of changes of both field observation and sweeping net data. The first peak occurred in May. After a gradual increase in March and April. During this peak, the coccinelid number reached a maximum of 9.5 and 66 individuals (Fig. 1) for observation and sweeping net data, respectively. Then, the number decreased in June and relatively in July (6.5 individuals). In sweeping net data, the population declined gradually in July (Fig. 1) after which they started to increase again to reach the second and highest peak of about 74 during October. Number then dropped down again during November, December to reach a lowest bottom of 1.5 on Jannary and 13 individuals on December for observation and sweeping net data, respectively.

In the 1997/98 year (Fig. 2): The population changes of the *Ch. Bipustulatus* follows a curve with two main peaks of both field observation and sweeping net data. The two peaks occurred during May (11.5 individuals) and October (14.0) for field observation and during April (65) and October (76) for sweeping net data.

C. undecimpunctata: Population fluctuations of the predator showed two peaks of abundance during spring and autumn in both years of study. The first peak was on April (7 individuals) and May (56) in the first year (Table 1 and Fig. 1) for the field observation and sweeping net data, respectively. While in the second year (Fig. 2, it was on May (7.5) and April (67) in field observation and sweeping net data, respectively. Than, the population decreased gradually and reached the lowest abundance during June- July in both years. The second peak was on October represented by 7.5 and 63 individuals during the first year and by 8.0 and 62 during the second year, according to the two methods of investigation respectively.

Cy. Vicina isis: this predator showed three peaks of abundance during April, September and January in the first year (Fig.1), while in the second year only two peaks were recorded during April and October (Fig.2). The first peak was the highest represented by 4 and 39 individuals in the first year and by 8.5 and 52 in the second for both observations, respectively. The lowest abundance of *Cy. Vicina isis* was recorded in winter months in both years of study.

R. cardinalis: Chr. Carnea and *S. syriacus* exhibited throughout the both years of study two peaks of abundance, namely in April and September with a relatively low numbers.

Cy vicina nilotica: proved to be the less numerous predator on infested citrus trees. It showed also two peaks of abundance in both years, in April and October.

3. Efficiency of predators on purple scale (PS) and floridared scale populations:

Predators attacking the purple scale (Figs. 3 and 4) showed three annual periods of activity throughout a year (in spring, summer and autumn). The

lowest activity was in winter. The highest efficiency (predatism %) of predators was 14.82% on the 16th of September (1996/1997). In 1997/98 it was 18.2% on the 13th of October. The percentage of perdation all over the year was 9.5±3.6 and 10.6±4.5% for the first and second year, respectively.

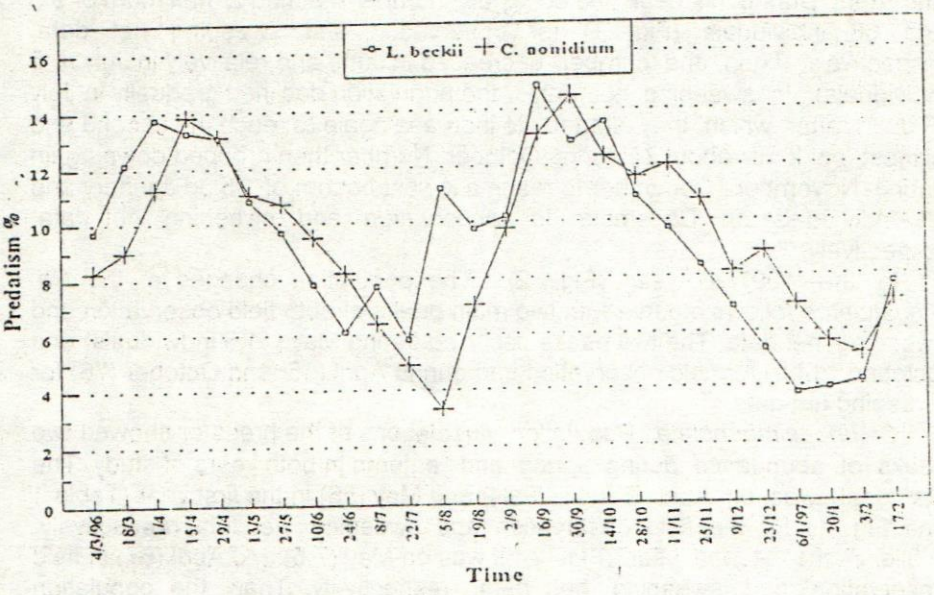

Fig. 3: Average mortality percentages of *L. beckii* and *C. aonidium* caused by predation during 1996/97

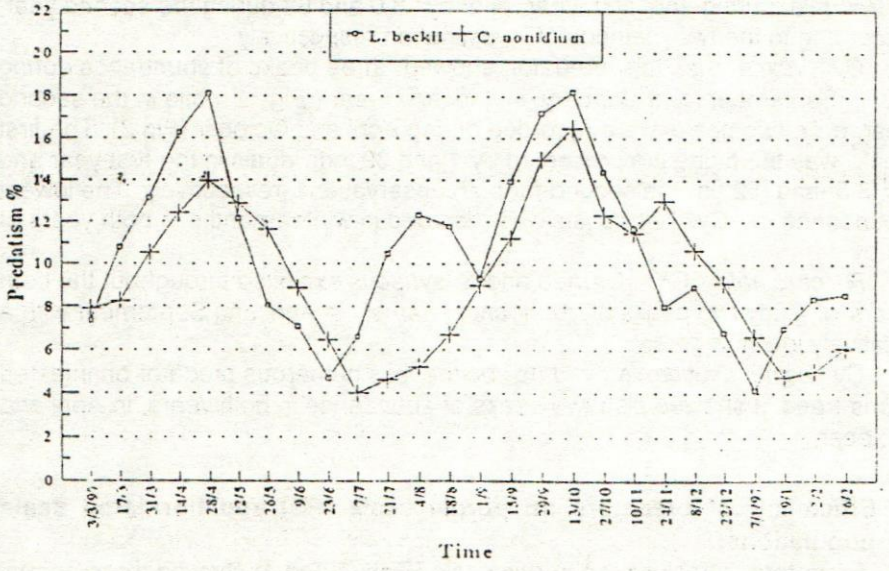

Fig. 4: Average mortality percentages of *L. beckii* and *C. aonidium* caused by predation during 1997/98

Regression analysis was fulfilled to evaluate the role of predation on suppressing *L. beckii* population. The efficiency of predation on the total mortality ™ in the first and second year was:

Pre.%= 4.43 + 0.09 TM% (for the 1st year)
Pre.%= 8.47 + 0.32 TM% (for the 2nd year)

With respect to the effect of predators on FRS population, it was relatively low in compartison with that of PS (Figs 3 and 4). The highest predation percentage do not exceed 16.5% in both years of study, it was in the 30th of September (14.49%) and in the 13th of October (16.52), respectively. As shown in Figs. (3 and 4), the predators showed two periods of activity on *C.aonidun* population. The first was in spring (especially in April) and the second in autumn (September-October). The lowest activity of all predators was recorded in the 5th of August and the 7th of July represented 3.3 and 4.0% for the first and second year, respectively. The percentage of predation all over the year was 9.3±3.0 and 9.4±3.5% for the first the first and second year, respectively.

The efficiency of predators on *C. aonidum* population was calculated as follows:

Pre.%= 7.75 + 0.17 TM% ((for the 1st year)
Pre.%= 0.39 + 0.22 TM% (for the 2nd year)

4. Searching rate of *Ch. bipustulatus* and *C. undecimpunctata*:

4.1. Under laboratory condition

The searching rate of both predators at different densities is illustrated in Fig. (5).

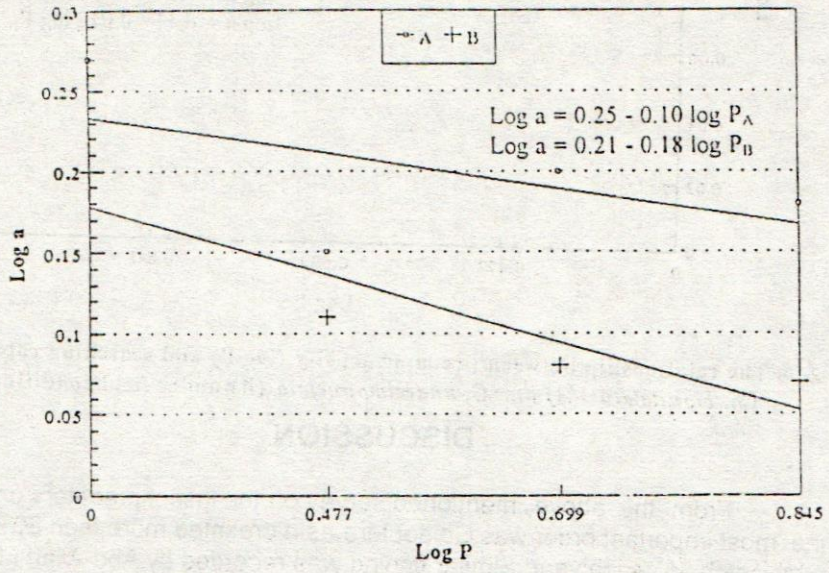

Fig. 5: The relationship between predator density (log P) and searching rate (log a) of *Ch. bipustalatus (A) or C. undecimpunctata (B)* under laboratory conditions.

Ch. bipustulalus adults showed relatively higher searching rate in comparison with *C. undecimpunctata*. By increasing predator density, the searching rate of *Ch. bipustulalus* was slightly decreased in comparison with *C. undecimpunctata* (Fig. 5). The mutual interference value for *Ch. bipustulalus* was 0.86. therefore, by increasing predator density, searching rate of *C. undecimpunctata* adult was sharply decreased in comparison with *Ch. bipustulalus*.

4.2. Under field conditions:

As shown in Figure (6), the searching rate of both tested predators is illustrated by deferent predator densities under field cage conditions. By increasing predator density, the searching rate was decreased especially with *C. undecimpunctata*. Generally, the searching rate of *Ch. bipustulalus* was relatively higher than *C. undecimpunctata*, at all densities *C. undecimpunctata* also showed higher mutual interference value (0.012) than *Ch. bipustulalus* (0.007) (Fig.6).

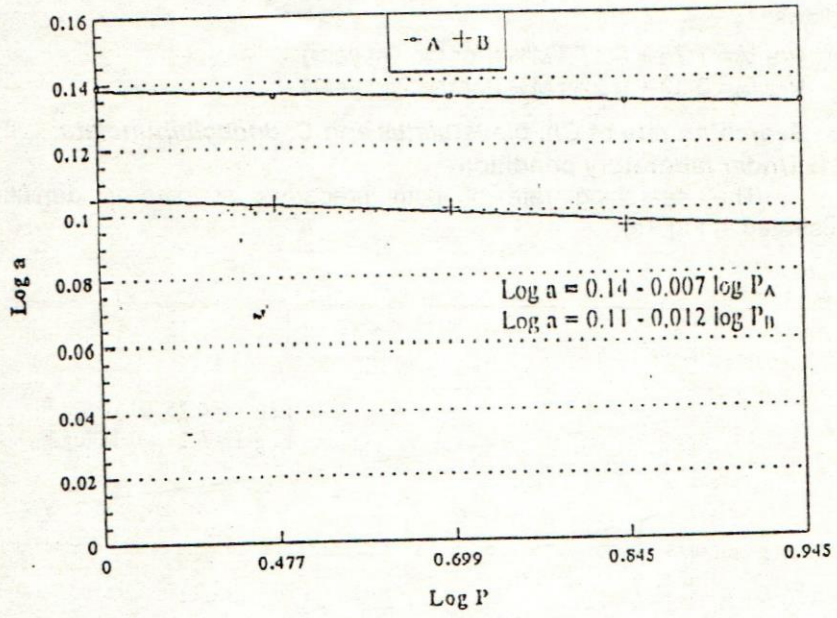

Fig. 6: The relationship between predator density (log P) and searching rate (log a) of *Ch. bipustalatus (A) and C. undecimpunctata* (B) under field conditions.

DISCUSSION

From the above mentioned survey on the insect predators on citrus, the most important order was Coleoptera as it presnted more than 80% of the total catch in each year. Similar finding was recorded by Abd-Allah (1988) in Mansoure region, as well as in Kafr El-Sheikh region (Metwally et al., 1993). The coccinellid species, of *Ch. bipustulalus* seems to be the most dominant

predator followed by *C. undecimpunctata* inhabiting citrus trees. According to Hodek (1973); Panis (1980) and Abou Hatab (1999) *Ch. bipustulalus* was the most important predator of scale insects It is on of the principal causes of increase of deas *L. backii* scale (Tawfik et al., 1974; Abd El-Rahman et al., 1980; Metwally et al., 1993 and Orphanides et al., 1996), as well as of dead C. aonidum scale (Rosen, 1967; Cilliers, 1971; Tawfik et al., 1974 and Hashem & El-Halawany, 1996).

The following predators were also recorded also as important enemies of *L. bechii* or *C. aonidunm*: *C.undecimpunctata* Gomaa (1996), *Chr.* Carnea (Yinon, 1969, and El-agamy et al., 1994), *S. syriacus* (Tawfik et al., 1970 and Gomaa, 1996), *Cy. Vicina* isis (Abd-Allah, 1988 and Gomaa, 1996), *R. cardinalis* (El-keiy, 1964 and abd-Allah, 1988).

In the present study, *Ch. bipustulatus* had two peaks annually, the first in may, and the second in October. The lowest abundance was recorded during winter and summer months. Similar results were recorded by Metwally et al. (1993). In Kafr El-sheikh, all insect predators inhabiting citrus trees had two peaks of abundance during April and September (El-Agamy et al., 1994).

Insect predators, especially *Ch. bipustulatus* as a mortality factor play a decisive role in preventing massive build up of scale insect populations (Cilliers, 1971; Abd El-Rahman *et al.*,1980 and El-Agamy *et al.*, 1994).

In the present study, the role of insect predators against both purple and Florida red scales was relatively high, especially against *L. bechii.*

The searching rate of *Ch. bipustulatus* was relatively higher than that of *C. undecimpunctata* adults under field and laboratory conditions. By increasing predator density, the searching rate of *C. undecimpunctata* adult was sharply decreased in comparison with *Ch. bipustulatus.* The relatively higher mutual interface, which occurred by increasing predator density, especially with *C. undecimpunctata* may cause a reduction of predator adult searching efficiency. A similar conclusion was reported by Podoler and Henen (1986) that *Ch. bipustulalus* changed its searching behaviour following successful enconuter with prey by increasing the angle and number of terns per unit of time and reducing their speed of locomotion. It returned to its original search pattern after a period of successful search. Also, it allocated an increasing proportion to their time to patches of prey as prey density increased.

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دراسات على بعض المفترسات الحشرية التى تهاجم حشرة الموالح المحاربة والحشرة الفشرية السوداء على أشجار البرتقال

ليلى عبد الستار البطران - عبد الستار إبراهيم عبد الكريم - حسن محمد فتحى - سامح أحمد مصطفى

قسم الحشرات الإقتصادية - كلية الزراعة - جامعة المنصورة

تم تقييم فعالية المفترسات الحشرية المرتبطة بتعداد كل من حشرة الموالح المحاربة والحشرة الفشرية السوداء على أشجار البرتقال خلال عامين متتاليين ١٩٩٦/١٩٩٧ ، ١٩٩٧/١٩٩٨ على التوالى.

وخلال هذه الدراسة كان المفترس *Chilocorus bipustulatus* أكثر المفترسات تواجداً وإنتشاراً. وقد سجل هذا المفترس ذروتى الوفرة العددية له فى الربيع والخريف فى كل من سنتى الدراسة وبصفه عامة تم تسجيل ثلاثة فترات لنشاط المفترسات على حشرة الموالح المحاربة خلال الربيع والصيف والخريف على التوالى وكانت أقل فترة لنشاط المفترسات خلال فصل الشتاء. وقد وصلت نسبة الإفتراس خلال العام الأول إلى ٩,٥ ±٣,٦ ، ١٠,٦ ± ٤,٠% فى السنة الأولى والثانية على التوالى.

وقد أظهرت المفترسات فترتين للنشاط على مجاميع الحشرة الفشرية السوداء خلال الربيع والخريف حيث بلغت نسبة التطفل على مدار العام إلى ٩,٣ ± ٣,٠ ، ٩,٤ ± ٣,٥ % فى السنة الأولى والثانية على التوالى.

أظهر المفترس *Ch. bipustulatus* معدل بحثى عالى بالمقارنة بالمفترس *Coccinella undecimpanctata* تحت الظروف المعملية والحقلية بالإضافة إلى أن المفترس الثانى أظهر قيم تداخل تبادلى أعلى مقارنة بالمفترس الأول.