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<b>ARABIC SUMMARY</b>	

# Summary

## Ecological and Biological Studies on Natural Enemies of some Scale Insects and Mealybugs

The current studies were carried out at navel orange orchards of two governorates; being El-Gharbia and Kafr El-Sheikh. The experimental period extended for two calendar years; beginning from April, 2005 up to March, 2007. Survey, population size and population fluctuations of scale insect and spider predators were investigated. Also, biological studies were conducted on *Nephus (Scymnus) includens* as an insect predator of hibiscus mealy bug, *Maconellicoccus hirsutus* (Green) in 2008. Effect of K.Z. mineral oil and Malathion on scale insects, mealybugs and their associated insect predators was investigated.

### 1. Survey of scale insects attacking citrus trees:

Five species of scale insects, belonging to Homoptera, were surveyed on navel orange trees. Three species of diaspidids; *Chrysomphalus ficus* Ashm, *Lepidosaphes beckii* New and *Aonidiella aurantii* Mask., and two of coccids; *Ceroplastes floridensis* Comst. and *Coccus hesperidum* L. were found.

### 2. Status of scale insects at Kafr El-Sheikh Governorate:

#### 2.1. Population size:

The population size of *C. ficus* was the highest while that of *Coccus hesperidum* was the lowest during the two seasons.

#### 2.2. Population fluctuations:

***C. ficus***: exhibited four peaks in each study season. In the first season, the peaks of both nymphs and adults occurred on July 1<sup>st</sup>, October 1<sup>st</sup>, December 15<sup>th</sup> and March 1<sup>st</sup>.

The corresponding values of the second season were detected on July 15<sup>th</sup>, October 15<sup>th</sup>, January 1<sup>st</sup> and March 1<sup>st</sup>.

***L. beckii***: had six peaks in 2005/06 season. The first and highest peak appeared on mid-April, while the smallest one was recorded by the beginning of March. In the second season, 2006/07 the population size of the insect exhibited four peaks; on mid-April, mid-July, mid-September and on mid-December.

**C. floridensis:** exhibited three peaks in each season; on mid-August, October 1-15, and mid-December.

**A. aurantii:** had three peaks in the first season; mid-August, first of November and first of December. In the second season, 2006/07 one peak was detected coinciding with the first of November, while the lowest population size of the insect extended from the beginning of April to mid-October and from mid-December until mid-March.

**C. hesperidum:** population size was high during one period extending from first of July to mid-November in the first season, and from first of June to first of November in the second season.

### **3. Status of scale insects at El-Gharbia Governorate:**

#### **3.1. Population size:**

In both seasons, the population size (nymphs and adults) of *L. beckii* was the highest, followed by that of *C. ficus*, *C. floridensis*, *A. aurantii* and *C. hesperidum*.

#### **3.2. Population fluctuations:**

**C. ficus:** had three peaks in the first season. The highest and conspicuous peak was on August 22<sup>nd</sup>, while the lowest peak was on March 7<sup>th</sup>. In the second season, the insect exhibited two peaks, the highest on August 22<sup>nd</sup>, and the lowest on March 22<sup>nd</sup>.

**L. beckii:** had four peaks in 2005/06 season, the highest peak on April 22<sup>nd</sup>, and the lowest one on December 22<sup>nd</sup>. In 2006/07 four peaks were recorded; the highest on April 22<sup>nd</sup>, while the lowest one was on November 7<sup>th</sup>.

**C. floridensis:** exhibited four peaks in the first season; the highest occurred on January 22<sup>nd</sup>, while the lowest one occurred on October 22<sup>nd</sup>. In the second season, the population fluctuations of the insect showed three peaks, the highest one appeared on July 22<sup>nd</sup>, while the lowest was recorded on February 7<sup>th</sup>.

**A. aurantii:** had three peaks in 2005/06 season, the lowest peak appeared on May 7<sup>th</sup>, while the highest one was recorded on December 7<sup>th</sup>. The insect completely disappeared from 22<sup>nd</sup> June to 7<sup>th</sup> August. In the second season, the insect population size increased gradually from 22<sup>nd</sup> September to 7<sup>th</sup> January and exhibited two peaks.

***C. hesperidum***: was recorded in three peaks in 2005/06 season. The highest peak was found on 7<sup>th</sup> July, while the lowest one was recorded on 7<sup>th</sup> September. In the second season, the population size of the insect exhibited four peaks. The highest peak was detected on 7<sup>th</sup> July, while the lowest one was detected on March 7<sup>th</sup>.

#### **4. Survey of mealybugs attacking citrus trees:**

Three species of mealybugs were surveyed from citrus trees at Kafr El-Sheikh and El-Gharbia Governorates. They were belonging to two families; Pseudococcidae (*Planococcus citri* Risso) and Margarodidae (*Icerya purchasi* Mask and *Icerya aegyptiaca* Doglus)

#### **5. Status of mealybugs at Kafr El-Sheikh Governorate:**

##### **5.1. Population size:**

Population size of *P. citri* was the highest followed by that of *I. purchasi* and then *I. aegyptiaca*.

##### **5.2. Population fluctuations:**

***P. citri***: exhibited three peaks in 2005/06 season; on mid-July, first of September, and first of February. In the second season, only two peaks were detected on first of July, and on first of September.

***I. purchasi***: population densities of the first season increased towards summer season, to exhibit the peak on August 15<sup>th</sup>. In the second season, a similar trend was obtained, with a gradual increase from the first of April up to mid-July, with the peak on the first of August.

***I. aegyptiaca***: exhibited two peaks on June 15<sup>th</sup> and first of August. In the second season, two peaks occurred, on first of July, and on first of September.

## **6. Status of mealybugs at El-Gharbia Governorate:**

### **6.1. Population size:**

Population of *P. citri* was the highest one, followed by *I. purchasi* and *I. aegyptiaca*.

### **6.2. Population fluctuations:**

***P. citri*:** had one peak in each season; on July 7<sup>th</sup> in the first season, and July 22<sup>nd</sup> in the second one.

***I. purchasi*:** was recorded as one peak on October 7<sup>th</sup> in 2005/06 season, and one peak was recorded on September 7<sup>th</sup> in 2006/07 season.

***I. aegyptiaca*:** exhibited only one peak in the first season; on October 7<sup>th</sup>. In the second season, three relative small peaks were recorded; on March 7<sup>th</sup>, on January 7<sup>th</sup> and on October 7<sup>th</sup>.

## **7. Survey of insect predators associated with citrus insect pests:**

Fifteen predatory insect species, belonging to five families and four orders were surveyed. Coleoptera was represented by twelve species belonging to two families; Coccinellidae and Staphylinidae. Diptera was only represented by only Syrphidae that had one species. Also, Hemiptera and Neuroptera was represented by Anthocoridae and Chrysopidae, respectively, as each family had only one species.

## **8. Status of insect predators at Kafr El-Sheikh Governorate:**

### **8.1. Population size:**

The highest population size was that of *Chilocorus bipustulatus* L., followed by *Scymnus* spp., *Paederus alfieri* Kock, *Rodalia cardinalis* Mulsant, *Chrysoperla carnea* Steph, *Syrphus corollae* Fab., *Cydonia vicina subsignata* Pic., *Coccinella undecimpunctata* L., *Orius* sp., and lastly *Exochomus flavipes* Thumberg.

### **8.2. Population fluctuations:**

***C. bipustulatus*:** adults exhibited three and two peaks of occurrence in 2005/06 and 2006/07 seasons, respectively. In the first season, they were detected on May 1<sup>st</sup>, June 1<sup>st</sup> and October 26<sup>th</sup>. The insect population was obviously low during December, January and February. In the second season, the predator appeared in two peaks; on June 1<sup>st</sup> and October 15<sup>th</sup>.



***Scymnus spp.:*** were recorded in two peaks in 2005/06 season, on April 15<sup>th</sup>, and on September 15<sup>th</sup>. Three peaks were recorded in 2006/07 season, on April 15<sup>th</sup>, August 1<sup>st</sup> and October 1<sup>st</sup>.

***P. alferii:*** Population densities showed three peaks of occurrence in the first season, and two peaks in the second one. The peaks of the first season were obtained on April 15<sup>th</sup>, August 15<sup>th</sup> and October 1<sup>st</sup>. In the second season, the peaks occurred on April 15<sup>th</sup> and on October 1<sup>st</sup>. This insect predator was found obviously in low population densities from December 1<sup>st</sup> up to March 15<sup>th</sup>.

***R. cardinalis:*** appeared in three and two peaks in the first and second seasons, respectively. In 2005/06 season, the highest peak occurred on September 15<sup>th</sup>, while the lowest one occurred on December 15<sup>th</sup>. In 2006/07 season, two peaks occurred on September 15<sup>th</sup>, and on January 15<sup>th</sup>.

***C. carnea:*** larval population was very low in both seasons, or absent during January, February and March. In 2005/06 season, four peaks of larvae were detected on June 1<sup>st</sup>, July 15<sup>th</sup>, October 1<sup>st</sup> and December 1<sup>st</sup>. In 2006/07 season, three peaks of larvae were recorded on May 15<sup>th</sup>, July 15<sup>th</sup> and on October 1<sup>st</sup>.

***S. corollae:*** larvae were detected in one peak in the first season (on August 15<sup>th</sup>), and in two peaks, in the second season (on May 15<sup>th</sup> and August 15<sup>th</sup>). The larval population densities were very low, or completely absent, from December up to March in both seasons.

***C. vicina subsignata:*** adults were recorded in two peaks of occurrence in 2005/06 season. The higher one was detected on October 1<sup>st</sup>, while the lower one was on May 15<sup>th</sup>. In 2006/07 season, two adult peaks occurred on May 15<sup>th</sup> and on October 15<sup>th</sup>.

***C. undecimpunctata:*** had two peaks in the first season, on April 15<sup>th</sup> and on October 1<sup>st</sup>. Also, two peaks were recorded in the second season on August 15<sup>th</sup> and October 1<sup>st</sup>.

***Orius sp.:*** was obtained in one peak per season; on October 1<sup>st</sup> in the first season, and on September 15<sup>th</sup> in the second one. In both seasons, the numbers were obviously low during January, February and March.

***E. flavipes***: adults 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.

## **9. Status of insect predators at El-Gharbia governorate:**

### **9.1. Population size:**

The most occurring predator was *C. bipustulatus*, followed by *Scymnus* spp. The lowest densities, were those of *C. undecimpunctata*, *Orius* sp. and *E. flavipes* in both seasons.

### **9.2. Population fluctuations:**

***C. bipustulatus***: adults were detected in four peaks; on May 7<sup>th</sup>, June 22<sup>nd</sup>, October 22<sup>nd</sup>, and January 1<sup>st</sup>. In the second season, the predator exhibited three peaks; on May 7<sup>th</sup>, June 22<sup>nd</sup> and October 22<sup>nd</sup>.

***Scymnus* spp.:** were found in three peaks in the first season, on June 22<sup>nd</sup>, August 7<sup>th</sup> and September 22<sup>nd</sup>. In the second season, only two peaks were recorded; on August 7<sup>th</sup> and on October 7<sup>th</sup>.

***P. alfieri***: was detected in two peaks in each season, on August 22<sup>nd</sup> and on October 22<sup>nd</sup> in the first season and on May 7<sup>th</sup> and October 7<sup>th</sup> in the second one.

***R. cardinalis***: adults exhibited two peaks of occurrence in each season. In the first one, the peaks appeared on October 7<sup>th</sup> and on January 1<sup>st</sup>. In the second season, the peaks appeared on September 22<sup>nd</sup> and on December 22<sup>nd</sup>.

***C. carnea***: larvae were not detected or rarely recorded in both seasons during January, February and March. In the first season, two peaks of larval occurrence were recorded on July 22<sup>nd</sup> and on October 22<sup>nd</sup>. In the second season, three peaks were recorded; on June 7<sup>th</sup>, July 22<sup>nd</sup> and October 7<sup>th</sup>.

***S. corollae***: exhibited two peaks of larval occurrence in the first season; on May 22<sup>nd</sup> and September 7<sup>th</sup>, and also two peaks occurred in the second season on May 22<sup>nd</sup> and September 7<sup>th</sup>.

***C. vicina subsignata***: adults were mainly detected, in both seasons, from May 22<sup>nd</sup> up to October 7<sup>th</sup>, while they were not recorded, or rarely, detected from October 22<sup>nd</sup> up to March 22<sup>nd</sup>.

***C. undecimpunctata***: was detected in two peaks in 2005/06 season, on April 22<sup>nd</sup> and October 7<sup>th</sup>. In 2006/07 season, also two peaks were observed; on May 7<sup>th</sup> and October 7<sup>th</sup>.

***Orius sp.***: exhibited two peaks in each season; on September 7<sup>th</sup> and October 7<sup>th</sup>.

***E flavipes***: was recorded in obviously low numbers, however, one small peak was recorded in each season.

## **10. True spiders:**

Ten true species and genera, belonging to nine families were surveyed from navel orange trees at Kafr El-Sheikh and El-Gharbia Governorates during 2005/06 and 2006/07 seasons.

### **10.1. Kafr El-Sheikh Governorate:**

#### **10.1.1. Population size:**

*Dictyna* sp. was the most occurring spider followed by *Cheriracanthium jovium* Denis, and *Theridion* sp. The least encountered true spider was *Agelenopsis* sp.

#### **10.1.2. Population fluctuations:**

***Dictyna sp.***: exhibited four peaks of occurrence in the first season; on July 1<sup>st</sup>, August 15<sup>th</sup>, October 15<sup>th</sup> and May 1<sup>st</sup>. In the second season, three peaks of occurrence were detected on April 15<sup>th</sup>, July 15<sup>th</sup> and September 1<sup>st</sup>.

***C. jovium***: had three peaks in the first season, on June 15<sup>th</sup>, August 15<sup>th</sup> and March 1<sup>st</sup>. In the second season, only two peaks were obtained; on June 1<sup>st</sup> and August 1<sup>st</sup>.

***Theridion sp.***: exhibited only one peak of occurrence in 2005/06 season, but no peaks were detected in 2006/07 season.

### **10.2. El-Gharbia Governorate:**

#### **10.2.1. Population size:**

*Dictyna* sp. was the most occurring spider, followed by *C. jovium* and *Theridion* sp. The least encountered spiders were *Agelenopsis* sp. and *Thomisius spinifers* D.P. Cambridge.

### **10.2.2. Population fluctuations:**

***Dictyna* sp.:** exhibited four peaks of occurrence in 2005/06 season; on May 22<sup>nd</sup>, June 22<sup>nd</sup>, August 7<sup>th</sup> and September 7<sup>th</sup>. In the second season, this spider appeared in two peaks; on May 22<sup>nd</sup> and August 22<sup>nd</sup>.

***C. jovium*:** had three peaks in the first season; on July 7<sup>th</sup>, August 22<sup>nd</sup> and October 7<sup>th</sup>. In the second season, only one peak was detected on July 22<sup>nd</sup>.

***Theridion* sp.:** exhibited one peak in the first season, on August 7<sup>th</sup>, and two peaks in the second season, on July 7<sup>th</sup> and August 7<sup>th</sup>.

The remaining spiders appeared in very low numbers in both seasons, and no peaks of any spider could be detected.

## **11. Biological studies on the predator, *Nephus (Scymnus) includens* (Kirsch):**

The larval stage of *N. includens*, reared on the mealy bug, *Maconellicoccus hirstutus* (Green), was completed in four instars, and lasted for 13.5 days. The third and fourth larval instars consumed about 66% of total consumed mealy bug nymphs. The adult stage lasted 52.65 days, and the female deposited about 335 eggs throughout the oviposition period, with an average of 8.48 eggs/female/day.

## **12. Effect of K.Z. mineral oil and Malathion on:**

### **12.1. Scale insects and mealybugs:**

The initial killing of K.Z. mineral oil against scale insects and mealybugs averaged 89.20%, and increased gradually to reach 100% twenty-one days after treatment, with an average 96.22% throughout the experimental period. The initial killing of Malathion against the same insects was very high (98.82%), with an average of 99.56% throughout the experimental period (21 days).

### **12.2. Associated predators:**

Malathion application was highly toxic against *C. bipustulatus*, *Scymnus* sp., *R. cardinalis*, *Cydonia* sp. and *C. carnea*, inducing complete mortality one day after application up to 21 days after application. However, K.Z. mineral oil was relatively less toxic to the same natural enemies, but twenty-one days after application, all considered insect predators were killed.