

POPULATION DENSITY OF THE MAIN MEALYBUG SPECIES ATTACKING MANGO TREES AND THEIR ASSOCIATED PREDATORY INSECTS AT MANSOURA REGION

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ABSTRACT

The present studies were carried out in the experimental farm belonging to the Faculty of Agriculture, Mansoura University to evaluate the population density of the main mealybug species attacking mango trees (*Mangifera indica* L.), and their the seasonal activity of the main associated predatory insects. Also the interaction between these insect pests and their associated predatory insects in two successive years 2013/14 and 2014/15. The highest peak of *Icerya aegyptiaca* was recorded in the first week of November 2013 (67 indiv.) during the first year and in the fourth week of September 2015 (59 indiv.) during the second year. *Icerya seychellarum* recorded the highest peak in the third week of November 2013 during the first year and in the first week of November 2014 in the second year and represented by 496 and 516 indiv., respectively. While, the highest peak of *Planococcus citri* was found in the third week of July 2014 (156 indiv.) and in the fourth week of September 2015 (281 indiv.) during the two successive years, respectively. Moreover, the obtained results showed that *Macnollicoccus hirsutus* had the highest peak in the fourth week of August 2014 (191 indiv.) during the first year and in the second week of August 2015 (227 indiv.) in the second year.

The highest peak of *Rodolia cardinalis* in the first week of November 2013 and represented by 84 and 93 indiv. for the two successive years 2013/14 and 2014/15, respectively. *Chrysoperla carnea* had the highest peak in the second week of August 2014 (37 indiv.) in the first year and in the end of the second year (43 indiv.). While, the highest peak of *Nephus includens* was found in the second week of August 2014 (22 indiv.) and in the second week of September 2015 (29 indiv.) for the two successive years, respectively. Meanwhile, the highest peak of *Scymnus coccivora* showed in the second week of August 2014 and 2015 for the two successive years and represented by 29 and 25 indiv., respectively.

The highest average number of the main predatory insects were recorded in autumn and summer seasons and were coincided with the highest average number of the mealybug species during the two successive years 2013/14 and 2014/15. A highly positive significant effect were recorded between the highest abundant of the mealybug species as *I. seychellarum* and *P. citri* and the highest abundant predatory insects as *R. cardinalis* and *C. carnea* during the two successive years.

INTRODUCTION

In Egypt, Mango (*Mangifera indica* L.) is considered the second important tropical fruit after bananas (El.Said 2006), and considered the king of fruits having delicious taste, captivating flavor with multifarious color and excellent source of nutritive values (Alam *et al.* 2006).

The different mealybug species are very injurious insect pests attacking mango trees cause serious damage, in addition, produce large amounts of the honeydew upon which saprophytic fungi develops, which interferes with photosynthesis and respiration and finally affecting quantity and quality of the fruits and causes economic loss in the crop (El-Dash 1997, Badawy *et al.* 2000, El-said 2006 and Mogahed and Abbas 2003).

Vedalia beetle *Rodolia cardinalis* Mulsant (Coleoptera: Coccinellidae) is an important coccinellid predator feeding on mealybug species (Ibrahim 2005 and Awadalla 2013).

Biological control by the use of the chrysopid predator *Chrysoperla carnea* has gained importance which the larvae have a ferocious appetite for aphids, mealybugs, immature scales, whiteflies, thrips, spider mites and others pests (Saminathan and Baskaran 1999), easy to mass production (Elarnaouty 1991).

Biological control strategy depends on using the natural enemies as one of the main objectives of the Integrated Pest Management (El-Sahn and Gaber 2012). The role of insect predators in controlling the mealybug species in fruit orchards and effect of different host plants on the attractiveness of the predators has been studied (Abd el-Salam *et al.* 2013).

Therefore, the objective of the present study was to determine the population density of the main mealybug species attacking mango trees and the activity of their associated predatory insects. As well as evaluate the relationship between the mealybug species and their predatory insects.

MATERIALS AND METHODS

The present studies were carried out in the experimental farm belonging to the Faculty of Agriculture, Mansoura University to evaluate the population density of the main mealybug species attacking mango trees (*Mangifera indica* L.), the seasonal activity of the main associated predatory insects and the interaction between these insect pests and their associated predatory insects during two successive years 2013/14 and 2014/15.

Five mango trees of the same age and size were chosen and used as replications. samples were taken biweekly during the successive years from the beginning of October 2013 till the end of September 2015. Each sample contained 100 leaves which were collected randomly from the five trees (twenty leaves from each tree). The collected leaves were taken to the laboratory in polyethylene bags for further investigation of the mealybug species and their associated predatory insects. The number of the mealybugs and their associated predators were identification and counted. The predatory insects which observed an each sample in spot close to the colonies of the mealybugs were collected by an aspirator and counted.

Data were analyzed using one-way ANOVA by Costat software program (2004).

RESULTS AND DISCUSSION

The population density of the main mealybug species and their associated predatory insects:-

Data presented in Fig. (1) showed that the population density of the main mealybug species attacking mango trees during the first year 2013/14 at Mansoura region. *I. aegyptiaca*

recorded two peaks of abundance, the first peak in the first week of November 2013 and the second one in the third week of June 2014 and represented by 67 and 56 individuals, respectively. While, *I. seychellarum* had four peaks of abundance in the third week of November 2013, in the 8th of May 2014, in the first week of July 2014 and third week of September 2014 and represented by 496, 245, 251 and 292 indiv., respectively. On the other hand, *P. citri* had two peaks, the first one in first week of November 2013 (116 indiv.) and the second peak in third week of July 2014 (156 indiv.). Moreover, *M. hirsutus* had two peaks of abundance in fourth week of October 2013 and in the fourth week of August 2014 and represented by 146 and 191 indiv., respectively.

The obtained data in Fig. (2) recorded the population density of the main mealybug species during the second year 2014/15 at Mansoura region. It can be noticed that, *I. aegyptiaca* had three peaks in the third week of November 2014, in the first week of June and in the end of the year (fourth week of September 2015) and represented by 48, 36 and 59 indiv., respectively. Also, *I. seychellarum* had three peaks of abundance and recorded in the first week of November 2014 (516 indiv.), in the first week of June (348 indiv.) and the end of the year (387 indiv.). Moreover, *P. citri* recorded three peaks in first week of November 2014 in the third week of June and in the fourth week of September 2015 and represented by 157, 124 and 281 indiv., respectively. On the other hand, *M. hirsutus* had only two peaks on mango trees during the second year 2014/15 and represented by 194 indiv. In the third week of November 2014 and 227 indiv. In the first week of August 2015.

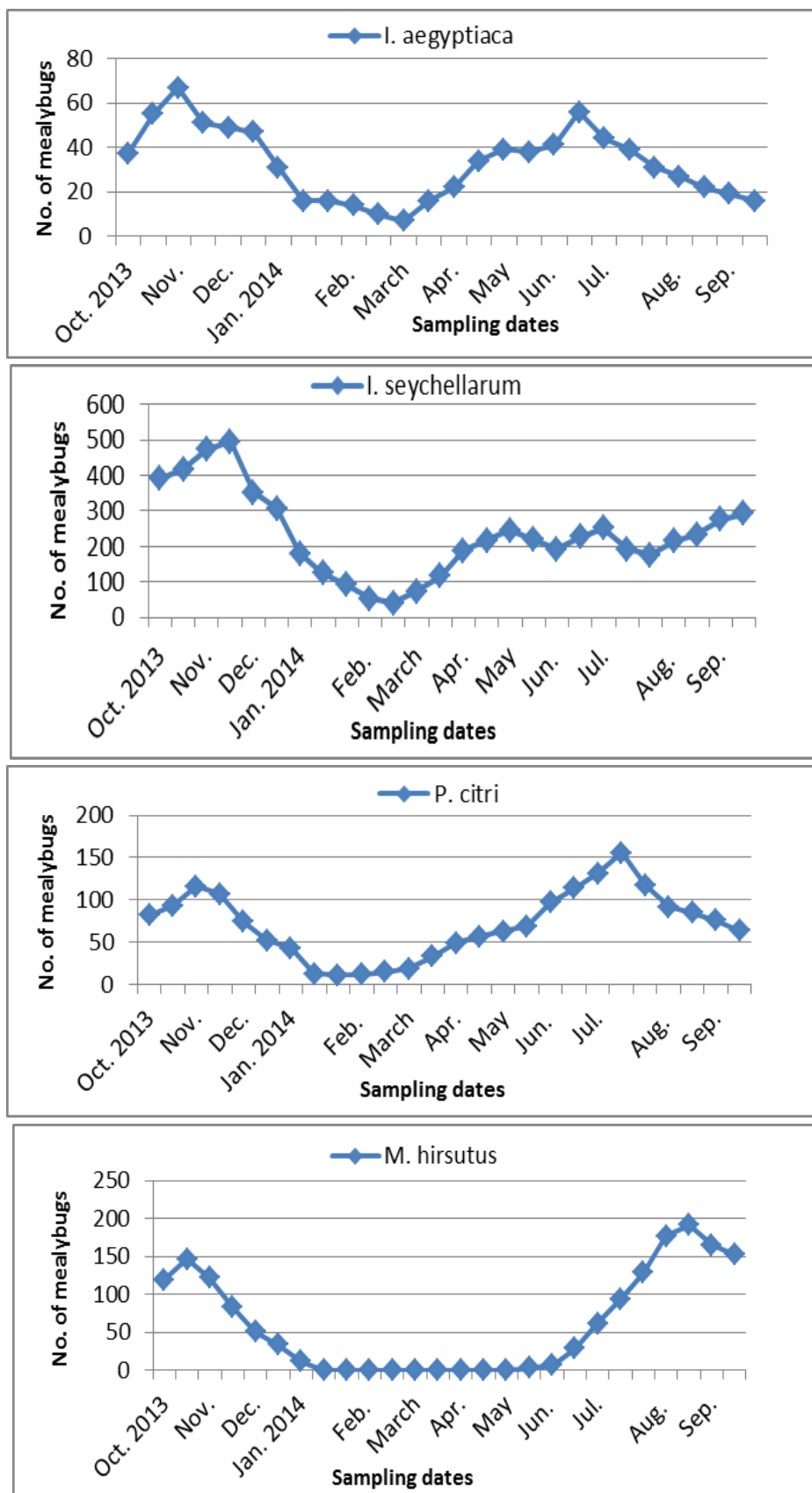


Fig. (1) The population density of the main mealybug species attacking mango trees during year 2013/14 at Mansoura region.

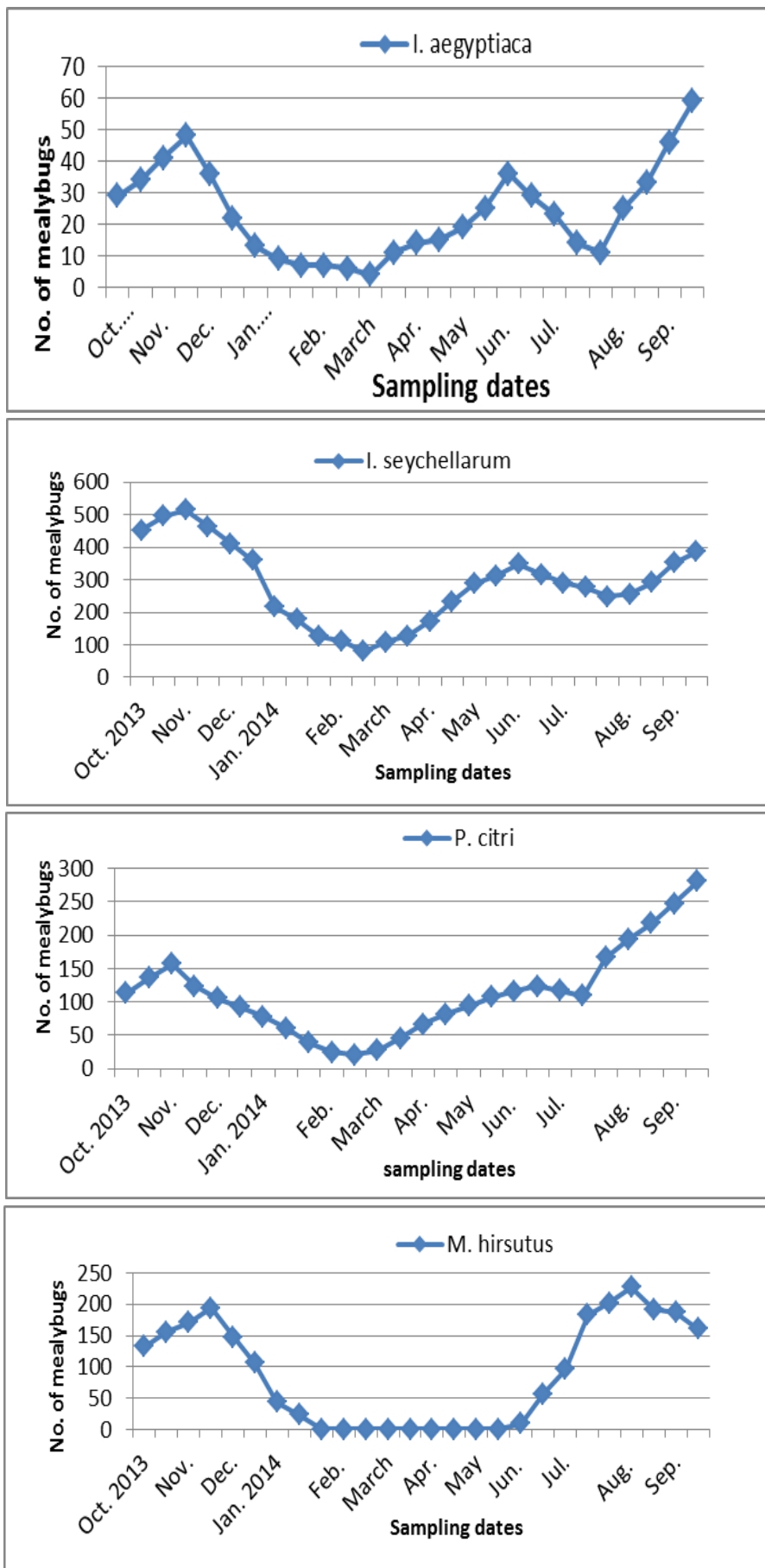


Fig. (2) The population density of the main mealybug species attacking mango trees during year 2014/15 at Mansoura region.

As conclusion, data arranged in Figs (1 and 2) indicated that, the highest peak of *I. aegyptiaca* was recorded in the first week of November 2013 (67 indiv.) during the first year and in the fourth week of September 2015 (59 indiv.) during the second year. *I. seychellarum* recorded the highest peak in the third week of November 2013 during the first year and in the first week of November 2014 in the second year and represented by 496 and 516 indiv., respectively. While, the highest peak of *P. citri* was recorded in the third week of July 2014 (156 indiv.) and in the fourth week of September 2015 (281 indiv.) during the two successive years, respectively. Moreover, *M. hirsutus* recorded the highest peak in the fourth week of August 2014 (191 indiv.) during the first year and in the second week of August 2015 (227 indiv.) in the second year.

Data arranged in Fig. (3) showed that the population density of the associated predatory insects on mango trees during the first year 2013/14 at Mansoura region. *R. cardinalis* recorded three peaks of abundance in the first week of December 2013, in the third week of May and in the end of July 2014 and represented by 84, 37 and 53 indiv., respectively. *C. carnea* had two peaks, the first one recorded in the third week of November 2013 (34 indiv.) and the second peak in the second week of August 2014 (37 indiv.). Also, *N. includens* had two peaks in the first week of December 2013 and in the second week of August 2014 and represented by 13 and 22 indiv., respectively. Moreover, *S. coccivora* had two peaks in the fourth week of October 2013 (21 indiv.) and in the second week of August 2014 (29 indiv.).

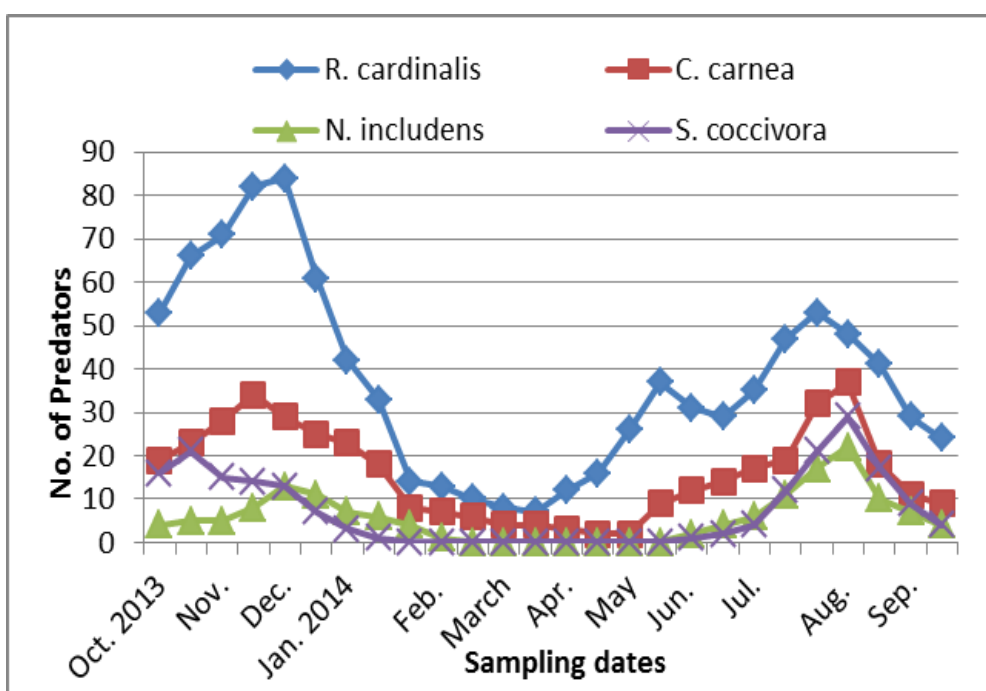


Fig. (3) The population density of the main predators inhabiting Mango trees during the first year 2013/14 at Mansoura region.

Data illustrated in Fig. (4) showed that the population density of the predatory insects inhabiting mango trees during the second year 2014/15 at Mansoura region. It can be noticed that, *R. cardinalis* recorded three peaks of abundance in the third week of November 2014, in the third week of June and in the fourth week of September 2015 and represented by 93, 61 and 67 indiv., respectively. *C. carnea* had also three peaks of abundance in the first week of December 2014

(32 indiv.) in the third week of June (29 indiv.) and in the end of September 2015 (43 indiv.). While, *N. includens* had two peaks of abundance in the beginning of December 2014 (16 indiv.) and in the second week of September 2015 (29 indiv.). Moreover, *S. coccivora* had two peaks of abundance in the third week of November 2014 and in the second week of August 2015 and represented by 17 and 25 indiv., respectively.

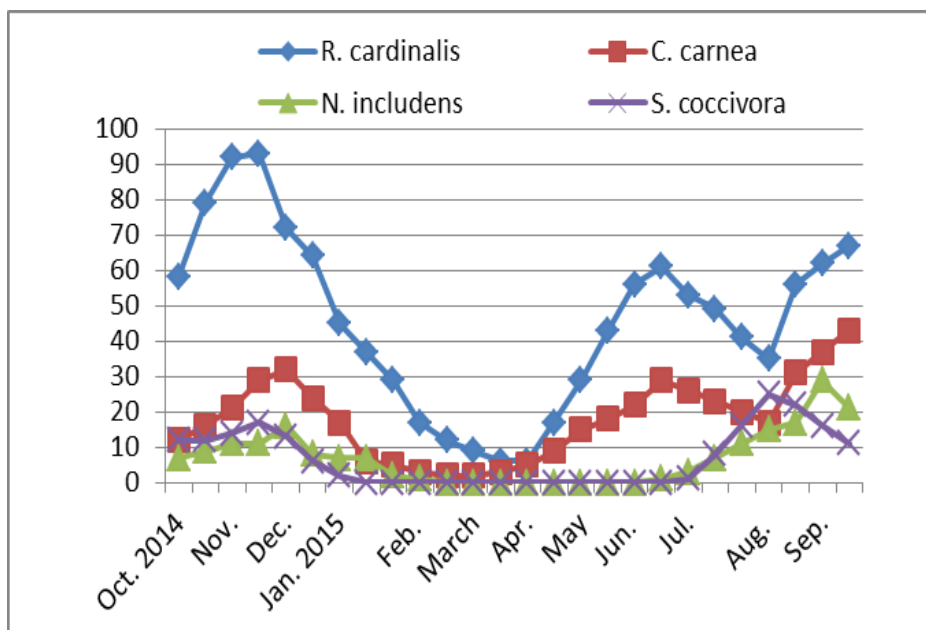


Fig. (4) The population density of the main predators inhabiting mango trees during the first year 2014/15 at Mansoura region.

As a conclusion data obtained in Figs (3 and 4) showed that, the highest peak of *R. cardinalis* in the first week of December 2013 and third week of November 2014 and represented by 84 and 93 indiv. for the two successive years 2013/14 and 2014/15, respectively. *C. carnea* had the highest peak in the second week of August 2014 (37 indiv.) in the first year and in the end of the second year (43 indiv.). While, the highest peak of *N. includens* recorded in the second week of August 2014 (22 indiv.) and in the second week of September 2015 (29 indiv.) for the two successive years, respectively. Meanwhile, the highest peak of *S. coccivora* showed in the second week of August 2014 and 2015 for the two successive years and represented by 29 and 25 indiv., respectively.

These results are agreement with those of Sayed (2008) and Bakry (2009) who found that, *I. seychellarum* had three peaks of abundance annually in May, August and October during two years of investigation on mango trees. Ghanim *et al.* (2013) studied the population density of common mealybug species attacking mandarin trees. They found that, the highest peak of *P. citri* on October while, *I. seychellarum* and *I. aegyptiaca* were recorded in September during the two years of study. Also, they found that the highest average number of *R. cardinalis* and *N. includens* were found in summer during the two seasons. Abdel-Salam *et al.* (2013) found that *P. citri* attractive to guava trees followed by mandarin and *I.*

seychellarum attractive to persimmon trees followed by guava, ficus and mandarin as a host plants. Fahad (2015) found that, *R. cardinalis* as predator associated with *I. seychellarum* on mango trees had three peaks annually and the highest peak in the beginning of October for the two successive years.

The relationship between the main mealybug species and their associated predatory insects:-

As shown in Table (1) data indicated that the seasonality average number of the main mealybug species and their associated predatory insects during the first year 2013/14. It can be noticed that, the highest average number for *I. aegyptiaca* and *I. seychellarum* were recorded in autumn and represented by 51.0 ± 4.11 and 405.7 ± 30.02 indiv., respectively. While, the highest average number for *P. citri* and *M. hirsutus* were recorded in summer during the first year and represented by 103.1 ± 12.67 and 138.6 ± 17.90 indiv., respectively.

Regarding to the predatory insects, the highest average number of *R. cardinalis*, *C. carnea* and *S. coccivora* were recorded in autumn and coincide with the highest average number of *I. aegyptiaca* and *I. seychellarum* and represented by 69.5 ± 5.02 , 26.3 ± 2.17 and 14.3 ± 1.89 indiv., respectively. On the other hand, *N. includens* had the highest average number in summer and coincide with the highest average number the highest number of *P. citri* and *M. hirsutus* and represented by 11.0 ± 2.47 individuals.

Tab. (1) Seasonality average number of the main mealybug species and predatory insects during the first year 2013/14.

| Insects | | Autumn | Winter | Spring | Summer | Annually Ave. |
|---------------------|------------------------|--------------|-------------|-------------|--------------|---------------|
| Mealybug species | <i>I. aegyptiaca</i> | 51±4.11a | 15.7±3.46c | 35.1±5.04b | 28.3±3.99b | 32.5±3.15 |
| | <i>I. seychellarum</i> | 405.7±30.02a | 94.5±21.64c | 201±16.06b | 233.9±16.25b | 232.5±23.59 |
| | <i>P. citri</i> | 87.3±9.7b | 18.8±5.07c | 68.9±10.75b | 103.1±12.67a | 70.8±7.83 |
| | <i>M. hirsutus</i> | 92.5±18.3b | 2±2.04c | 5.6±4.1c | 138.6±17.9a | 60.6±13.24 |
| Associated predator | <i>R. cardinalis</i> | 69.5±5.02a | 20±5.84c | 22.6±4.24c | 39.6±4.1b | 37.4±4.42 |
| | <i>C. carnea</i> | 26.3±2.17a | 11±3.18b | 6.6±1.93c | 20.4±3.99a | 15.9±2.07 |
| | <i>N. includens</i> | 7.7±1.53b | 3±1.29c | 0.9±0.60d | 11±2.47a | 5.7±1.11 |
| | <i>S. coccivora</i> | 14.3±1.89a | 0.7±0.50b | 0.4±0.30b | 13.7±3.55a | 7.3±1.66 |

Means followed by the same letters in horizontal rows are not significantly difference 0.05 level of probability (Duncan's Multiple Range Test)

The obtained data in Table (1) indicated that, the lowest average number of the mealybug species were coincided with the lowest average number of the predatory insects and were recorded in winter season during the first year of the study.

Data illustrated in Table (2) showed that, the highest average number for *I. aegyptiaca* and *I. seychellarum* were recorded in autumn season during the second year of the study and represented by

35.0±3.78 and 450.0±23.85 indiv., respectively. Meanwhile, the highest average number for *P. citri* and *M. hirsutus* were recorded in summer season and represented by 190.3±24.73 and 178.3±15.93 indiv., respectively. Statistical analysis revealed that, a highly significant differences were obtained for each mealybug species or each predatory insects between the different seasons during the two successive years.

Tab. (2) Seasonality average number of the main mealybug species and predatory insects during the second year 2014/15.

| Insects | | Autumn | Winter | Spring | Summer | Annually Ave. |
|---------------------|------------------------|--------------|--------------|-------------|--------------|---------------|
| Mealybug species | <i>I. aegyptiaca</i> | 35±3.78a | 7.7±1.28c | 21.3±3.5b | 30.1±6.66a | 23.7±2.88 |
| | <i>I. seychellarum</i> | 450±23.85a | 137.2±21.02c | 257±31.58b | 300.4±19.6b0 | 285.6±24.39 |
| | <i>P. citri</i> | 121.2±9.67b | 41.7±9.6c | 19.6±10.88c | 190.3±24.73a | 113.2±13.08 |
| | <i>M. hirsutus</i> | 150.2±12.73a | 11.2±7.72b | 9.4±8.17b | 178.3±15.93a | 88.0±16.59 |
| Associated predator | <i>R. cardinalis</i> | 76.3±6.00a | 24.8±6.03c | 31.1±8.77c | 51.9±4.33b | 45.7±4.95 |
| | <i>C. carnea</i> | 22.3±3.17a | 5.8±2.38c | 14.4±3.62c | 28.1±3.61a | 17.9±2.26 |
| | <i>N. includens</i> | 10.3±1.33a | 2.8±1.38b | 0.14±0.15b | 14.7±3.37a | 7.03±1.51 |
| | <i>S. coccivora</i> | 12.3±1.5a | 0.33±0.34b | 0±0b | 14.1±3.17a | 6.7±1.57 |

Means followed by the same letters in horizontal rows are not significantly difference 0.05 level of probability (Duncan's Multiple Range Test)

summer seasons and were coincided with the highest average number of the mealybug species during the two successive years 2013/14 and 2014/15.

As a conclusion, the obtained data in Tables (1 and 2) indicated that, the highest average number of the main predatory insects were recorded in autumn and

Tab. (3) Simple correlation coefficient between mealybug species and their associated predatory insects on mango trees during years 2013/14 at Mansoura region

| Predators | Mealybug species | | | | | | | |
|----------------------|----------------------|--------|------------------------|--------|-----------------|--------|--------------------|--------|
| | <i>I. aegyptiaca</i> | | <i>I. seychellarum</i> | | <i>P. citri</i> | | <i>M. hirsutus</i> | |
| | r | P | r | P | r | P | r | P |
| <i>R. cardinalis</i> | 0.745*** | 0.0001 | 0.813*** | 0.0001 | 0.576** | 0.0021 | 0.492* | 0.0107 |
| <i>C. carnea</i> | 0.522** | 0.0063 | 0.563** | 0.0027 | 0.529** | 0.0055 | 0.567** | 0.0025 |
| <i>N. includens</i> | 0.209 ^{ns} | 0.3055 | 0.250 ^{ns} | 0.2179 | 0.461* | 0.0179 | 0.625*** | 0.0006 |
| <i>S. coccivora</i> | 0.365 ^{ns} | 0.0664 | 0.549** | 0.0037 | 0.571** | 0.0023 | 0.841*** | 0.0001 |

* Significant with varied degrees
r correlation coefficient

P probability

The obtained data in Table (3) showed that the simple correlation coefficient between the different mealybug species attacking mango trees and their associated predatory insects at Mansoura region during the first year 2013/14. It can be noticed that, a highly

positive significant effect were recorded between the mealybug species and predatory insects. Only *N. includens* showed a positive insignificantly effect with *I. aegyptiaca* and *I. seychellarum* and predator *S. coccivora* with *I. aegyptiaca*.

Tab. (4) Simple correlation coefficient between mealybug species and their associated predatory insects on mango trees during years 2014/15 at Mansoura region

| Predators | Mealybug species | | | | | | | |
|----------------------|----------------------|--------|------------------------|--------|-----------------|--------|--------------------|--------|
| | <i>I. aegyptiaca</i> | | <i>I. seychellarum</i> | | <i>P. citri</i> | | <i>M. hirsutus</i> | |
| | r | P | r | P | r | P | r | P |
| <i>R. cardinalis</i> | 0.809*** | 0.0001 | 0.916*** | 0.0001 | 0.593** | 0.0014 | 0.690*** | 0.0001 |
| <i>C. carnea</i> | 0.838*** | 0.0001 | 0.678*** | 0.0001 | 0.833*** | 0.0001 | 0.681*** | 0.0001 |
| <i>N. includens</i> | 0.674*** | 0.0002 | 0.490* | 0.0110 | 0.828*** | 0.0001 | 0.813*** | 0.0001 |
| <i>S. coccivora</i> | 0.568** | 0.0025 | 0.547** | 0.0038 | 0.739*** | 0.0001 | 0.933*** | 0.0001 |

* Significant with varied degrees
r correlation coefficient

P probability

The arranged data in Table (4) revealed that, a highly positive significant effect were recorded between the mealybug species and their associated predators on mango trees during the second year. Only predator *N. includens* with *I. seychellarum* showed a positive significant effect during the second year.

As a conclusion, the obtained data in Tables (3 and 4) indicated that, a highly positive significant effect were recorded between the main and the highest abundant of the mealybug species as *I. seychellarum* and *P. citri* and the main predatory insects as *R. cardinalis* and *C. carnea* during the two successive years 2013/14 and 2014/15.

These results are in agreement with those of Copland *et al.* (1993) they recorded that, the searching behavior of *Nephus reunioni* on different host plants

infested with *P. citri* and found that, the predator was most active on citrus as host plants. El-Serafi *et al.* (2004) found that, *R. cardinalis* and *C. carnea* were the associated predators with the mealybug species infesting guava trees. Abdel-Mageed (2011) found that, the most common predator associated with the pink hibiscus mealybug *M. hirsutus* was *S. coccivora* and observed with relatively high numbers on hibiscus and exhibited three peaks of abundance in both years of study 2006 and 2007. Abdel-Salam *et al.* (2013) recorded that, *R. cardinalis*, *C. carnea* and *N. includens* were the main predators associated with the mealybug species attacking fruit orchards. Mohamed (2013) found that *R. cardinalis*, *C. carnea*, *N. includens* and *Exochomus falvipes* were associated with mealybug species attacking grapes vine trees at Mansoura district.

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الكثافة العددية لأهم أنواع البق الدقيقي التي تهاجم أشجار المانجو ومفترساتها الحشرية المصاحبة لها في منطقة المنصورة

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أجريت هذه الدراسة في المزرعة البحثية التابعة لكلية الزراعة – جامعة المنصورة وذلك لتقدير الكثافة العددية لأهم أنواع البق الدقيقي التي تهاجم أشجار المانجو والنشاط الموسمي لأهم مفترساتها الحشرية المصاحبة لها وكذلك التداخل بين هزم الآفات الحشرية والمفترسات الحشرية المرتبطة بها خلال سنتي الدراسة ٢٠١٣/٢٠١٤ و ٢٠١٤/٢٠١٥.

سجل البق الدقيقي المصري أعلى ذروة للتعداد في الأسبوع الأول من نوفمبر ٢٠١٣ (٦٧ فرداً) خلال السنة الأولى والاسبوع الرابع من سبتمبر ٢٠١٥ (٥٩ فرداً) خلال السنة الثانية.

سجل البق الدقيقي السيشلارم ذروة للتعداد في الأسبوع الثالث من نوفمبر ٢٠١٣ خلال السنة الأولى والاسبوع الأول من نوفمبر ٢٠١٤ خلال السنة الثانية بمعدل (٤٩٦ & ٥١٦ فرداً) على التوالي. بينما كانت أعلى ذروة لبق الموالح الدقيقي كان في الأسبوع الثالث من يولييه ٢٠١٤ (١٥٦ فرد) والأسبوع الرابع من سبتمبر ٢٠١٥ (٢٨١ فرد) على مدار سنتي الدراسة على التوالي. علاوة على ذلك سجل بق الهيسكس الدقيقي أعلى ذروة للتعداد في الاسبوع الرابع من أغسطس ٢٠١٤ (١٩١ فرد) خلال السنة الأولى وفي الاسبوع الثاني من أغسطس ٢٠١٥ (٢٢٧ فرداً) خلال السنة الثانية.

أظهر المفترس أبو العيد فيداليا أعلى تعداد في الأسبوع الأول من نوفمبر ٢٠١٣ وكان (٨٤ & ٩٣ فرداً) خلال سنتي الدراسة على التوالي. سجل المفترس أسد المن الاخضر أعلى ذروة تعداد في الاسبوع الثاني من أغسطس ٢٠١٤ (٣٧ فرد) في السنة الأولى وفي نهاية السنة الثانية بمعدل ٤٣ فرد. بينما سجل المفترس *N. includens* أعلى ذروة تعداد في الاسبوع الثاني من أغسطس ٢٠١٤ (٢٢ فرد) والاسبوع الثاني من سبتمبر ٢٠١٥ (٢٩ فرداً) خلال سنتي الدراسة على التوالي. بينما أعلى ذروة تعداد لمفترس *S. coccivora* كانت في الاسبوع الثاني من أغسطس ٢٠١٤ و ٢٠١٥ خلال سنتي الدراسة (٢٩ و ٢٥ فرداً على التوالي).

أظهرت النتائج أن أعلى متوسط لتعداد المفترسات الحشرية كان في فصلي الخريف والصيف وكان ذلك متزامناً مع أعلى متوسط تعداد لأنواع البق الدقيقي خلال سنتي الدراسة. وقد سجلت النتائج وجود فروق عالية المعنوية وموجبة بين أعلى وفرة عددية من أنواع البق الدقيقي مثل البق الدقيقي السيشلارم وبق الموالح الدقيقي وأهم المفترسات الحشرية وفرة مثل أبو العيد فيداليا و أسد المن خلال سنتي الدراسة.