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Ecological studies on two mealybug species (Hemiptera) and their predator on navel orange trees at Qalubiya Governorate, Egypt

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Abstract:

Citrus mealybug *Planococcus citri* (Risso) (Hemiptera: Pseudococcidae) and Egyptian fluted mealybug, *Icerya aegyptiaca* (Douglus) (Hemiptera: Monophlebidea) are serious insect pests, attack the navel orange trees and cause a severely considerable damage. The present study aimed to determine mealybug generations under the studied conditions and the proper time for their control. Field studies were carried out on *P. citri* and *I. aegyptiaca* on 100 navel orange leaves and 25 twigs in half monthly samples, at a private farm in Qalubiya Governorate, Egypt throughout two years 2018 and 2019. The obtained results showed that *P. citri* population had three peaks of infestation in the first year (2018) in June 1st, July 2nd and August 2nd. In the second year (2019) two peaks were recorded on 1st week of July and 2nd week of September. The Egyptian mealybug *I. aegyptiaca* had one peak in both years occurred in the second week of September in first year and in second week of October the second year. Two peaks of abundance during the first year 2018 recorded for the associated predator, *Rodolia cardinalis* (Mulsant) (Coleoptera: Coccinellidae), in June 2nd and in the October 1st. During the second year of study, it had two peaks in June 1st and October 1st. There was simultaneous occurrence of the total population of *P. citri and I. aegyptiaca* and its associated predator *R. cardinalis*. Positive correlation between Max., Min. temperatures and the total population of *P. citri and I. aegyptiaca* was determined. On the other side there were negative correlation of relative humidity and total population during the two years of study.

Introduction

Citrus is the most important fruit in Egypt as far as its acreage, production and exportation potentials are concerned (El-Kassas, 1984). Mealybugs are serious insect pests, attack the citrus trees and cause a severely considerable damage under the prevailing agroecosystems in Egypt. These insects are sucking pest of plant sap and secret large amount of the honey dew which encourage the growth of sooty mold fungi, that consequently reduce the photosynthesis and respiration of plant leaves. Usually, occurrence of the sever infestation lead to the death of the whole trees (Radwan, 2003).

The citrus mealybug, *Planococcus citri* (Risso) (Hemiptera: Pseudococcidae) is an important pest attacking several crops. Biotic and abiotic factors, as well as the substrate they feed on influence its population (Correa *et al*., 2005). The citrus mealy bug infested 65 plant species belonging to 56 genera in 36 families and distributed in 20 Governorates. *P. citri* prefers citrus followed by guava and grape (Ahmed and Abd-Rabou, 2010).

The genus *Icerya* includes about 35 species in the world that are commonly known as fluted scales because of the fluted appearance of the ovisac. The Egyptian fluted mealybug, *Icerya aegyptiaca* (Douglus) (Hemiptera: Monophlebidea) has the most distributed in the world and with numerous host plants. It is commonly known as Egyptian *Icerya*, because of it is original description from Egypt. This monophlebid scale causes considerable damage on *Mangifera indica* and tropical fruit trees in Chahbahar (Moghaddam *et al*., 2015).

Therefore, the present study aimed to shedding light on two species of mealybugs infesting navel orange trees and their associated predatory insect as well as their seasonal abundances in Qalubiya Governorate, Egypt. And to determine its generations under the studied conditions and the proper time for their control.

Materials and methods

The present studies were conducted at a private farm in Qalubiya Governorate, Egypt. All the agricultural practice was carried out except the insecticide's applications. To evaluate the seasonal abundance of the mealybug species and their associated predators, 100 navel orange leaves and 25 twigs were taken from five navel orange trees of the same age and same size as half monthly samples (each tree was considered as a replicate and 20 leaves and five twigs were taken randomly from each tree representing the four cardinal directions). Samples were collected half monthly from early January till the end of December during the two successive years 2018 and 2019. The collected samples were transferred to the laboratory in paper bags for examination by the aid of a binocular stereomicroscope, Identification of mealybug species and their insect predator was done by taxonomy specialists at the Department of Scale Insects and Mealy bugs, Plant Protection Research Institute, Dokki, Egypt. The mealybug species and their associated insect predators for each sample were identified and counted. The upper and lower surfaces of the leaves were carefully examined. The rate of increase/decrease in population densities was calculated by dividing the mean number of insects found in the sample over that found in preceding one as described by (Bodenheimer, 1951). Statistical analysis for the data were analyzed by using one-way ANOVA by Costat software program (2004).

Results and discussion

1. The population abundance of two mealybug species and their predator:

1.1. Population density of *Planococcus citri*:

The obtained results in Figure (1) showed that the estimated fluctuating densities of the *P. citri* population indicated three peaks of infestation in the first year (2018). These peaks occurred in June 1st, July 2nd and August 2nd with values of 320, 512 and 685 individuals, respectively. In the second year (2019), two peaks were recorded on 1st week of July (362 individuals) and 2nd week of September (457 individuals) as shown in Figure (2).

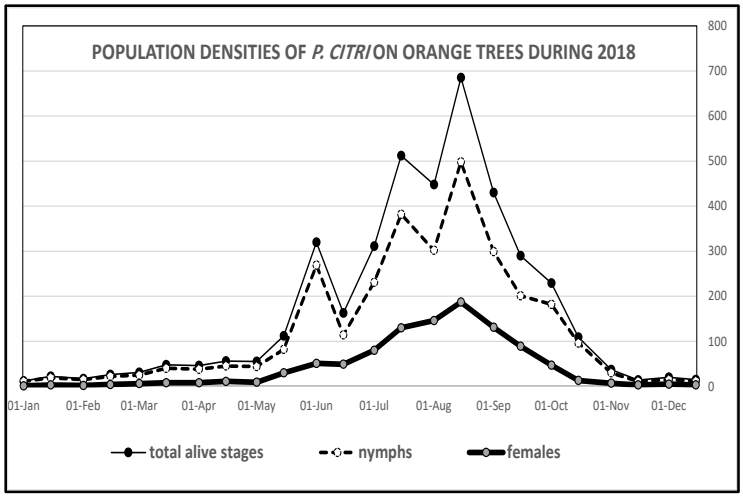

Figure (1): Population density of *Planococcus citri* on navel orange trees in 2018.

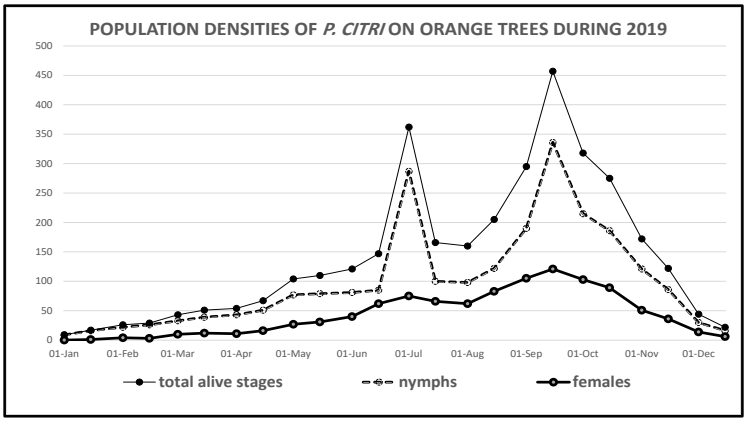

Figure (2): Population density of *Planococcus citri* on navel orange trees in 2019.

1.2. Population density of *Icerya aegyptiaca*:

The Egyptian mealybug *I. aegyptiaca* had one peak in the first year, occurred in the second week of September (148 individuals) as shown in Figure (3). In the second year (2019) one peak was recorded in the second week of October (112 individuals) as shown in Figure (4). These results are similar to those of (Ghanim *et al*., 2013) who studied the population density of 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. Another study by (Moustafa, 2012) on citrus trees in Behira showed that the insect population of *P. citri* reached maximum during May in first and second years, respectively, also results indicated that citus mealybug, *P. citri* has two peaks on citrus trees in Cairo. Mesbah (2008) in Egypt recorded *P. citri* and *I. aegyptiaca* infesting pomegranate and occurred with high numbers during the two seasons 2005 and 2006. Our results of P. citri disagree with those of (Awadalla, 2017) who recorded two peaks of citrus mealybug P. citri on pomegranate trees in Mansoura, and agreed with those recorded for *I. aegyptiaca* (One peak of abundance during 2014 and 2015).

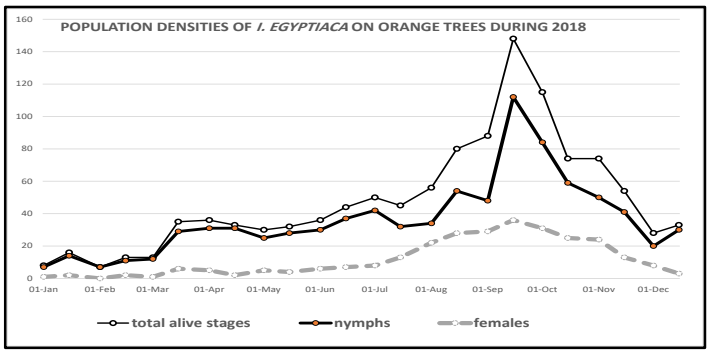

Figure (3): Population density of *Icerya aegyptiaca* on navel orange trees in 2018.

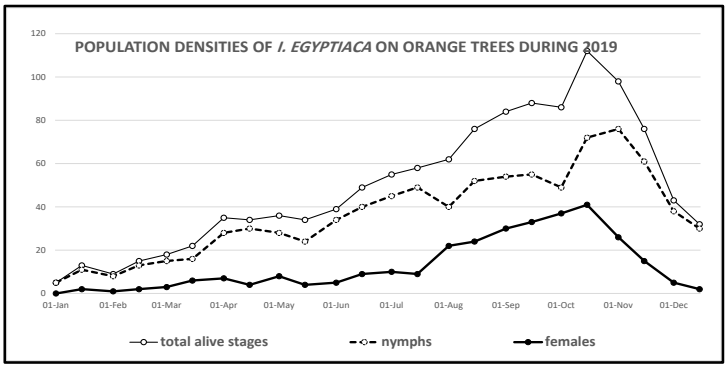

Figure (4): Population density of *Icerya aegyptiaca* on navel orange trees in 2019.

1.3. Population density of associated predator *Rodolia cardinalis*:

Data illustrated in Figure (5) revealed that, *R. cardinalis* had two peaks of abundance during the first year 2018, the first one was recorded in the June 2nd (25 individuals) and the second peak in the October 1st (32 individuals). During the second year of study, *R. cardinalis* had two peaks in June 1st and October 1st, and represented by 21 and 35 individuals, respectively as illustrated in Figure (5). (Ghanim *et al*., 2013) recorded that this predator associated with the mealybug species and had three peaks in Mandarin trees at Mansoura district.

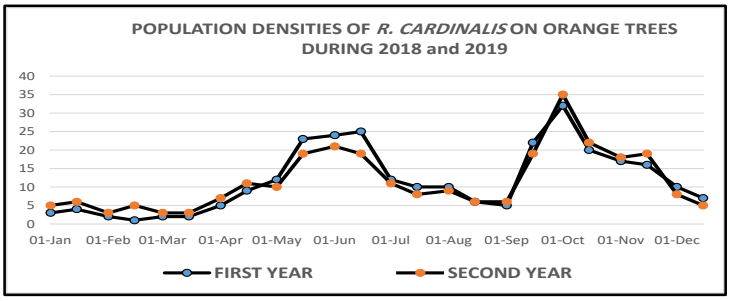

Figure (5): Population density of *Rodolia cardinalis* on navel orange trees in 2018 and 2019.

2. Number of annual generations:

The mealybug *P.citri* has three annual generations throughout the first year of study (2018), and two annual generations throughout the second year of study (2019) of the insect population under field condition at Qalubiya Governorate. During the first year of investigation, the percentage of nymphal population of *P.citri* recorded 84%, 74% and 72.7 % of total population through June 1st, July 2nd and August 2nd, respectively. In the 2nd year (2019), two annual generations existed, in July 1st (79 %) and September 2nd (74%). The mealybug *I. aegyptiaca* has one annual generation, and these results were ensured throughout the two years of study of the insect population under field condition at Qalubiya Governorate. The percentage of nymph population of *I. aegyptiaca* recorded 67.5% of total population in September 2nd and 64.3% of total population in October 2nd in first and second years of study, respectively.

Results concerning the Monthly variation rate (MVR) of population density of *P. citri* clearly show that the favorable periods for its development and population increase were at April, June and September where (MVR) values averaged 2.1, 2.9 and 1.9, respectively as shown in Figure (6). In the second year the highest values of (MVR) were in February (1.5), July (2.4), and September (1.9) as shown in Figure (6). Monthly variation rate (MVR) of population density of *I. aegyptiaca* illustrated in Figure (7) shows that the favorable periods for its development and population increase were at February, July and August where (MVR) values averaged 1.8, 2.4 and 1.6, respectively. In the second year the highest values of (MVR) were in February (1.6), March (2.6), and June (2.1) as shown in Figure (7). These results are in harmony with (Khalil *et al*., 2011) who found three annual generations of the purple scale *Lepidosaphes beckii* Newm. (Hemiptera: Diaspididae) on navel orange throughout the two years of study of the insect population under field condition at El-Behaira.

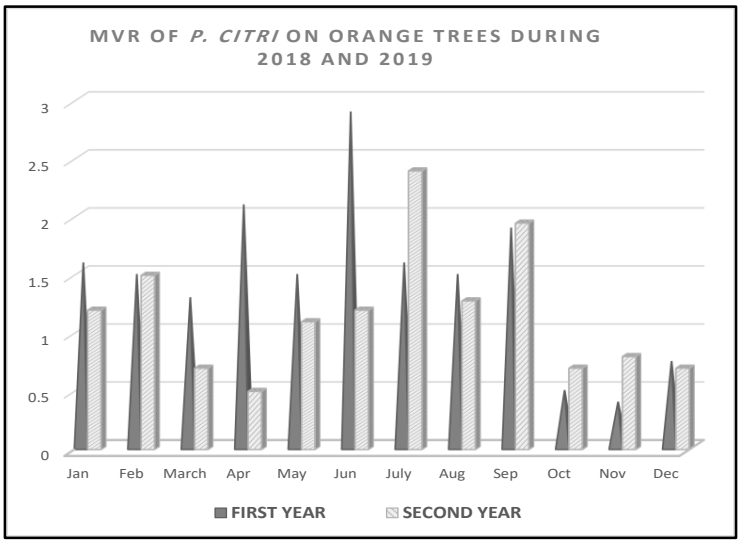

Figure (6): Monthly variation rate (MVR) of population density of *Planococcus citri* on navel orange trees in 2018 and 2019.

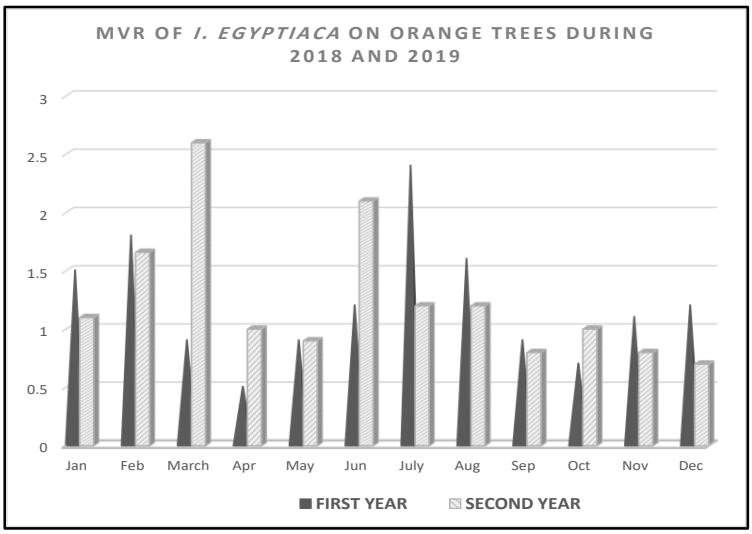

Figure (7): Monthly variation rate (MVR) of population density of *Icerya aegyptiaca* on navel orange trees in 2018 and 2019.

3. The relationship between *Planococcus citri* and *Icerya aegyptiaca* and their associated insect predator *Rodolia cardinalis*:

The obtained results showed that there was simultaneous occurrence of the total population of *P. citri* and *I. aegyptiaca* and its associated predator *R. cardinalis*.

The obtained results are in agreement with the finding of (Mesbah, 2008) in Egypt, suggested that, the relationship between the predator *R. cardinalis* and *I. aegyptiaca* showed a significant difference during the two season 2005 and 2006. Also, *(*Mani and Krishnamoorthy, 2000) in India, recorded that, the natural enemies parasitiods and predators effectively reduced the population density of *P. citri.* Developmental stages of *R. cardinalis* have been found to be associated with populations of *I. aegyptiaca* on Ficus nitida trees in the Mansoura district of Egypt. The development of *R. cardinalis* larvae when reared in culture on *Icerya aegyptiaca* (Douglas) (Hemiptera: Coccoidea: Monophlebidae) was significantly faster than that fed on *Icerya purchasi* Maskell (Hemiptera: Coccoidea: Monophlebidae). The results indicate that *R. cardinalis* is well adapted to *I. aegyptiaca* in Egypt (Ragab, 1991). This work agrees with the findings recorded by Hamid and Hassanian (1991) who recorded the predator *R. cardinals* associated with monophlebid, *Icerya* spp.

4. Effect of prevailing hygro-thermic condition on the population density of *Planococcus citri* and *Icerya aegyptiaca*:

The effect of Max., Min. temperatures and relative humidity on the total population of *P. citri* and *I. aegyptiaca* during the two studied years determined positive correlation between Max., Min. temperatures and the total population (r = 0.51 and 0.53) in the two years of study respectively, while the higher temperatures, the higher population. On the other side there were week negative correlation of relative humidity and total population value (r) was -.243 and -0.314 during the two years of study in Qalubiya Governorate respectively. Ahmed and Abd-Rabou (2010) observed that the host plants and temperature greatly influenced on the development of *P. citri* and the lowering of temperature increase the dimension of the mealybug

and lengthen the developmental period. These results agreed with (Zaki *et al.*, (2013) mentioned that there were significant effects of temperatures on *I. seychellarum* total population during 2011 and there were insignificant effects of relative humidity during the two years of study in Qalyubyia and Giza Governorates. Also, (Moustafa, 2012) reported that there were positively high significant correlations between I. seychellarum population and both of mean temperature and relative humidity at Demyaata Governorate.

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