

Use of the Coccinellid Predator, *Cryptolaemus montrouzieri* Mulsant against the Striped Mealybug, *Ferrisia virgata* (Ckll.) on the Ornamental Plant, *Acalypha macrophylla* in Egypt

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ABSTRACT

The coccinellid predator, *Cryptolaemus montrouzieri* Muls. was used to control the striped mealybug, *Ferrisia virgata* (Ckll.) on the ornamental plant *Acalypha macrophylla* at Giza region< Egypt. Adults of the predator were released once on October, 1st, 2006 in the open field at different rates; *i.e.*, 10 and 20 adults of *Cryptolaemus* / shrub of *A. macrophylla*. Results showed that the optimum release rate was 10 *Cryptolaemus* adults / shrub of *Acalypha*, and with this rate, the predator had the ability to reduce the population of the pest. In the 8th week after the predator release, the percentage of reduction of *F. virgata* reached to 89.6 for crawlers, 75.01 for nymphs and 67.62 % for adults and increased in the 11th week after release to reach 99.99 for crawlers, 89.25 for nymphs and 95.39 % for adults.

Key Words: *Ferrisia virgata*, *Cryptolaemus montrouzieri*, *Acalypha macrophylla*, Release, Egypt.

INTRODUCTION

Mealybugs have become major pests of many ornamental and fruit plants in Egypt. Among the mealybug species, *Ferrisia virgata* (Ckll.), *Planococcus ficus* (Signoret), *Planococcus citri* (Risso) and *Maconellicoccus hirsutus* (Green) are dominant and commonly found in Egypt.

Cryptolaemus montrouzieri Muls. (Coleoptera: Coccinellidae) is a mealybug predator, both larvae and adults attack all mealybug different stages. The predator is most effective in high infestation, but if food is scarce, it feeds on soft scale insects and aphids. The coccinellid grub consumed a total of 900 to 1500 *Maconellicoccus* eggs during its development (Mani and Thontadarya, 1987 a), compared with the coccinellid predator, *Scymnus coccivora* (Ayyar) which consumed about 300 *Maconellicoccus* eggs (Mani and Thontadarya, 1987 b). This indicates the efficiency of *C. montrouzieri* in reducing the mealybug populations.

C. montrouzieri was used by several authors to regulate and reduce the populations of different mealybugs ; *e.g.*, *P. citri* in Indiana (USA) (Averbeck and Haddock 1984), *P. ficus* in former USSR (Rzaeva,1985), in India, *M. hirsutus* on grapes (Babu and Azam 1989), (Reddy *et al.*, 1991) and in Greece (Hamid and Michelakis 1997), in India, on acid lime and guava (Mani and Krishnamoorthy, 1999 and 2001) and populations of *F. virgata* on guava trees (Mani *et al.*, 1990).

Biological control measures against mealybugs in Egypt by using *C. montrouzieri*, started 1926. It was

reared and distributed on a limited scale as its rearing was time consuming. Even though the insect feeds freely on various species of mealybugs and the expenses involved for its continuous breeding and feeding made it very costly. Thus, due to its low reproductive potential, slow spreading, the necessary protection to stand our winter conditions, and the annual release of new colonies, the work on this predator species was abandoned (Kamal, 1951). After 55 years from the previous work , in 2006, a second trial to introduce this coccinellid predator from France to Egypt to be reared in the *Chrysopa* Mass Production Laboratory, Faculty of Agriculture, Cairo University, was carried out and to be used against mealybugs in Egypt.

The present work aims to evaluate the efficacy of *C. montrouzieri* in different rates of releases against the populations of *F. virgata* on the ornamental plant, *Acalypha macrophylla* in Giza region, Egypt.

MATERIALS AND METHODS

C. montrouzieri was imported from France and reared on the mealybug, *P. ficus* infesting pumpkin fruits at 26±2 °C and 60–70% R.H.; using the same technique followed by Attia (2003). Twenty day old adults were used for releases after they had completed pre-mating and pre-ovipositional periods (Mani and Thontadarya, 1987 a).

Releases occurred on shrubs grown in the garden of the Fac. Agric., Cairo Univ. and were made once on October, 1st, 2006 in the early morning, at two release rates, *i.e.* 10 and 20 of *Cryptolaemus* adults per *Acalypha* shrub. Three *Acalypha* shrubs were

used in each treatment in addition to the control. Five branches from each shrub, 20 cm long, were chosen and labeled. Sampling was carried out four times a month, starting on the 30th of September 2006 (Just prior to release) until 30th of December 2006. Field monitoring was carried out, during which numbers of *F. virgata* crawlers, nymphs and adults as well as numbers of larvae and adults of *C. montrouzieri* were counted and recorded.

Percentage of reduction in the mealybugs population was calculated using the formula of Henderson and Tilton (1955) as follows:

$$\text{Reduction \%} = 1 - \frac{T_a \times c_b}{T_b \times c_a}$$

Where: c_b and c_a = Number of insects in control before and after treatment

T_b and T_a = Number of insects in treatment before and after treatment

Meteorological data were obtained from the nearest meteorological station at Giza; data on weather parameters, minimum, maximum temperatures and relative humidity were obtained during the period of study.

One way ANOVA statistical analysis method was performed to analyze the effect of the two rates of releases on the mean numbers of *F. virgata* (Crawlers, nymphs and adults) in the treated shrubs.

RESULTS AND DISCUSSION

During the study period, maximum temperature ranged from 13 to 34.57 °C, while minimum temperature ranged 5.64 to 20.45°C. The associated relative humidity reached a minimum of 52.34 % and a maximum of 63.06 % (Fig. 1).

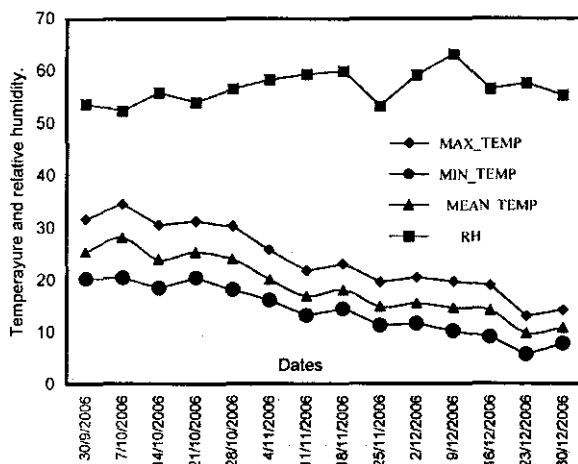


Fig.(1): Weekly max., min. and mean of temperature and mean of relative humidity at Giza region during the period of investigation.

1. Mealybug population density

Population records of *F. virgata* at the two rates of releases; T1 (10 *Cryptolaemus* adults/shrub), T2 (20 *Cryptolaemus* adults / shrub) in addition to the control (no release) are disclosed in Figs.(2, 3 and 4) as well the percentages of reduction are summarized in Table (1).

1.1. Crawlers of *F. virgata*

As shown in (Fig.2), the earliest records on 30/09/06, just prior to release of the predator showed that their mean numbers were 467.13 ± 34.70 , 725.87 ± 124.27 and 447.27 ± 38.06 individuals/branch in T1, T2 and control, respectively.

In the 6th week after release, on 11/11/2006, the crawlers population density decreased to 106.67 ± 73.67 and 154.73 ± 87.61 individuals/branch in T1 and T2, respectively (Fig.2). The percentages of reduction reached 86.63 and 87.52%, (Table 1). However, in the control, the population density reached a maximum of 764.07 ± 52.26 individuals/branch.

In the 8th week after release, on 25/11/2006, the population continued to decrease in T1 and T2, to reach 66.53 ± 8.13 and 46.33 ± 7.89 individuals/branch, respectively (Fig.2). The percentages of reduction reached 89.6 and 95.34 % (Table 1), however, 612.53 ± 91.86 individuals/branch were counted in the control shrubs.

In the, 11th week after release (on 16/12/2006), no mealybug crawlers were presented in T1 and T2, and a reduction of 99.99 % was recorded. On the other hand, 285.63 ± 60.34 individuals/branch were

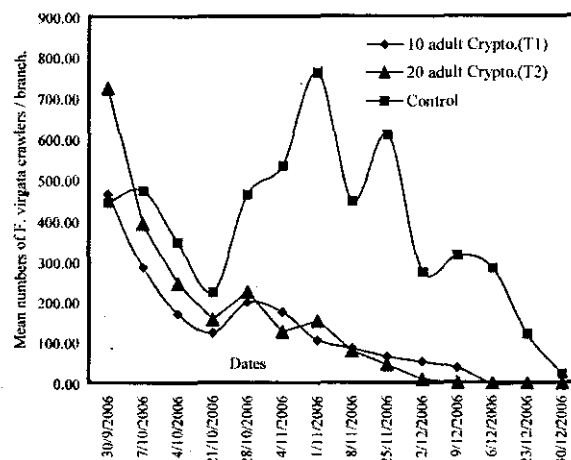


Fig.(2): Mean numbers of *F. virgata* crawlers per branch of *A. macrophylla* in the two treatments and control after releasing *C. montrouzieri* at Giza region, 2006.

Table (1): Reduction % of *F. virgata* population (Crawlers, nymphs and adults) post release of the coccinellid predator *Cryptolaemus montrouzieri* (Muls.) on *Acalypha macrophylla* at Giza region, 2006.

| Date | % Reduction | | | | | |
|------------|-------------|-------|--------|-------|--------|-------|
| | Crawlers | | Nymphs | | Adults | |
| | T1 | T2 | T1 | T2 | T1 | T2 |
| 7/10/2006 | 42.07 | 48.73 | 8.89 | 12.88 | 12.90 | 24.10 |
| 14/10/2006 | 53.1 | 56.56 | 17.4 | 35.13 | 29.76 | 57.76 |
| 21/10/2006 | 47.28 | 57.08 | 28.47 | 46.8 | 33.16 | 54.61 |
| 28/10/2006 | 58.88 | 70.06 | 49.77 | 63.06 | 41.80 | 45.42 |
| 04/11/2006 | 68.65 | 85.32 | 50.98 | 65.05 | 40.09 | 59.49 |
| 11/11/2006 | 86.63 | 87.52 | 65.50 | 63.93 | 44.13 | 57.37 |
| 18/11/2006 | 81.57 | 89.05 | 70.51 | 81.15 | 53.92 | 58.37 |
| 25/11/2006 | 89.60 | 95.34 | 75.01 | 83.74 | 67.62 | 79.04 |
| 02/12/2006 | 81.33 | 97.56 | 78.63 | 84.85 | 70.87 | 83.16 |
| 09/12/2006 | 88.33 | 99.61 | 80.30 | 95.68 | 76.4 | 94.71 |
| 16/12/2006 | 99.99 | 99.99 | 89.25 | 97.06 | 95.39 | 96.56 |
| 23/12/2006 | 99.99 | 99.99 | 98.85 | 98.52 | 94.42 | 93.74 |
| 30/12/2006 | 99.96 | 99.98 | 98.80 | 99.61 | 97.67 | 98.59 |

counted in control shrubs.

Analysis of variance for the mean numbers of *F. virgata* crawlers in T1, T2 and control shrubs during the period of investigation (Table 2), showed highly significant differences between records of the two treatments and the control means; 93.18, 111.38 and 377.41 crawlers / branch. LSD 0.5% was 44.45; with no significant difference between the two rates of release T1 and T2.

1.2. Nymphs of *F. virgata*

Data (Fig.3) showed that their mean numbers

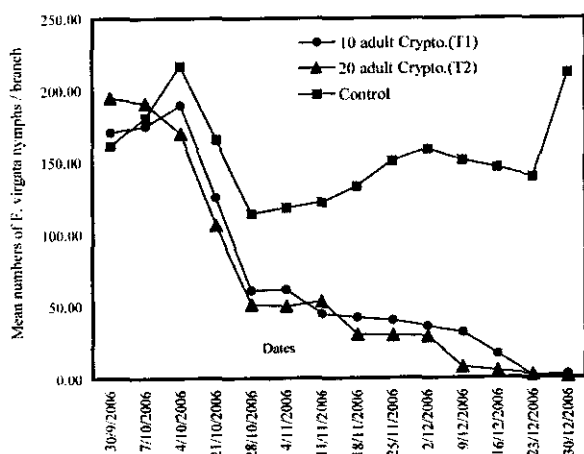


Fig. (3): Mean numbers of *F. virgata* nymphs per branch of *A. macrophylla* in the two treatments and control after releasing *C. montrouzieri* at Giza region, 2006

were 170.87 (± 20.25), 195 (± 21.23) and 161.40 (± 11.84) individuals/branch, just prior to the predator release (on 30/9/2006) for T1, T2 and control, respectively.

In the 6th week after release (on 11/11/2006), the nymphs population density dropped to 44.68 \pm 6.30, 53.27 \pm 2.61 and 122.27 \pm 16.00 individuals/branch in the T1, T2 and control shrubs, respectively. The percentage of reduction among nymphs of *F. virgata* (Table 1) reached 65.5 and 63.93% for the two respective treatments.

In the 8th week of release (on 25/11/2006), the nymphs population showed further drop; representing 39.93 \pm 4.82 and 29.64 \pm 6.78 individuals/branch (*i.e.* 75.01 and 83.74% reduction) in T1, T2 respectively, opposed to 150.87 \pm 8.82 individuals/branch in the control shrubs.

In the 11th week after release, (on 16/12/2006), the remaining nymphs population reached 16.65 \pm 2.83 and 5.20 \pm 0.94 individuals/branch in T1 and T2, respectively (*i.e.* 89.25 and 97.06% reductions), opposed to 146.27 \pm 27.60 individuals/branch in the control.

Data presented in table (2), showed highly significant differences between records of the both T1, T2 treatments and the control; with no significant difference between T1 and T2 at 0.5%.

1.3. Adults of *F. virgata*

Data (Fig. 4) showed that the respective mean numbers were 18.6 \pm 1.47, 16.6 \pm 1.02 and 18 \pm 1.88 individuals/branch just prior to the predator release in T1, T2 and the control shrubs.

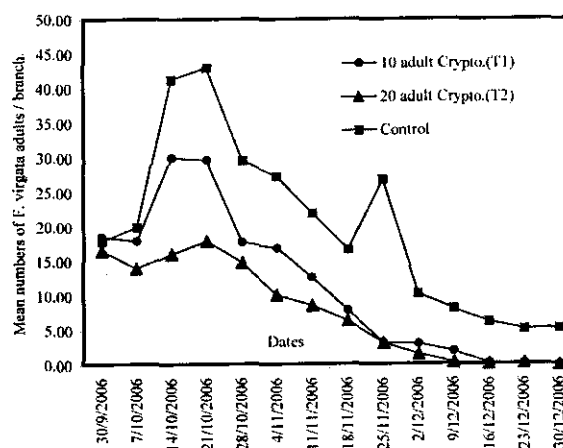


Fig. (4): Means numbers of *F. virgata* adults per branch of *A. macrophylla* in the two treatments and control after releasing *C. montrouzieri* at Giza region, 2006.

In the 6th week after release (on 11/11/2006), the adults population density dropped to 12.73 ± 0.77 and 8.65 ± 1.72 individuals/branch in T1 and T2, respectively (i.e. 44.13 and 57.37% reduction) (Table 1), opposed $22 + 3.43$ individuals / branch in the control.

In the 8th week after release (on 25/11/2006), the adult population dropped further to 3.27 ± 1.23 and 3.20 ± 0.57 individuals / branch in T1 and T2 (i.e. 67.62, 79.04 % reduction), while it increased to 26.87 ± 0.66 individuals/branch in the control.

In the 11th week after release (on 16/12/2006), the remaining adult population was $0.33 + 0.25$ and 0.20 ± 0.16 individuals/branch in T1 and T2, respectively, while it was 6.3 ± 1.06 individuals/branch in the control shrubs. Thus, respective reductions were 95.39 and 96.56%.

Analysis of variance for the mean number of *F. virgata* adults showed significant differences between treatments (LSD 0.5% was 1.71) when the greatest number of adults were recorded in the control shrubs (20.18 individuals/ branch), opposed to the respective figures of 10.94, 7.23 individuals/branch in T1 and T2 (Table 2).

In conclusion, *C. montrouzieri* had the ability to reduce the population of *F. virgata*. Results indicated that, in the 8th week after releasing the predator (25/11/2006), the percentage of reduction of *F. virgata* reached to 89.6 and 95.34 %, for crawlers, 75.01 and 83.74% for nymphs and 67.62 and 79.04% for adults in T1 and T2 treatments, respectively. In the 11th week of release (16/12/2006), the percentage of reduction was increased to reach 99.99% for crawlers, 89.25 and

Table (2): Analysis of variance of the mean numbers of crawlers, nymphs and adults of *F. virgata* in the two treatments and the control shrubs during the period of investigation.

| <i>F. virgata</i> | T1 | T2 | Control |
|-------------------|----------|----------|----------|
| Mean | 93.18A | 111.38 A | 377.41 B |
| Crawlers | F. value | 100.83 | |
| | LSD | 44.45 | |
| Mean | 66.78A | 55.96 A | 154.77 B |
| Nymphs | F. value | 109.67 | |
| | LSD | 14.52 | |
| Mean | 10.94A | 7.23 B | 20.18 C |
| Adults | F. value | 120.13 | |
| | LSD | 1.71 | |

Means have the same letters in rows are not significantly different at 0.05% prob.

97.06 % for nymphs and 95.39 and 96.56 % for adults in the T1 and T2, respectively. The here above results agree with the previous investigation of Mani *et al.* (1990) which showed that by using the coccinellid predator *C. montrouzieri*, the mealybug *F. virgata* population decreased from 145.3/plant to 2.8/plant after 40 days of release. In 2001, Mani and Krishnamoorthy released the predator *C. montrouzieri* at a ratio of 20 beetles/guava tree to suppress the mealybug, *M. hirsutus*. A drastic reduction occurred in the mealybug population from 918.50 to 4.6/plant after three months of release. Also, when releasing the predator *C. montrouzieri* to control the mealybug, *Rastrococcus invadens* on Sapota trees, its population declined from an initial infestation of 507.6 / shoot to nil, in two months time.(Mani *et al.*, 2004).

2. Densities of *Cryptolaemus*

2.1. *Cryptolaemus* larvae

The highest population of *Cryptolaemus* larvae was recorded in the 2nd week after release (on 14/10/2006), when 1.6 and 1.8 individuals/ branch were recorded in the T1 and T2, respectively, (Fig. 5) The associated maximum, minimum respective temperatures and relative humidity were 30.57, 18.43°C and 55.83% R.H. % .In the 4th and 6th week after release, the population decreased to 0.47 ± 0.09 , 0.6 ± 0.08 and 0.2 ± 0.08 , 0.53 ± 0.12 individuals/ branch in T1 and T2. No larvae of *Cryptolaemus* were recorded in the two treatments from 18/11 until 30/12/2006, except in the 9th and 10th weeks when 0.2 ± 0.08 and 0.07 ± 0.02 individuals/branch were recorded in T2. The absence of *Cryptolaemus* larvae during this period referred to its pupation.

Analysis of variance for the mean numbers of

Table (3): Analysis of variance of the mean numbers of Larvae and adults of the two predators; *Scymnus* and *Cryptolaemus* in the two treatments and the control shrubs during the period of investigation

| Predators | T1 | T2 | Control |
|----------------------------|----------|----------|----------|
| Mean | 0.1846 A | 0.2205 A | 0.6718 B |
| <i>Scymnus</i> larvae | F. value | 24.56 | |
| | LSD | 0.1537 | |
| Mean | 0.1692 A | 0.2205 A | 0.3539 B |
| <i>Scymnus</i> adults | F. value | 5.24 | |
| | LSD | 0.1168 | |
| Mean | 0.2359 A | 0.3846 A | 0 |
| <i>Cryptolaemus</i> larvae | F. value | 3.77 | |
| | LSD | 0.153 | |
| Mean | 0.0051 A | 0.0359 B | 0 |
| <i>Cryptolaemus</i> adults | F. value | 5.67 | |
| | LSD | 0.0258 | |

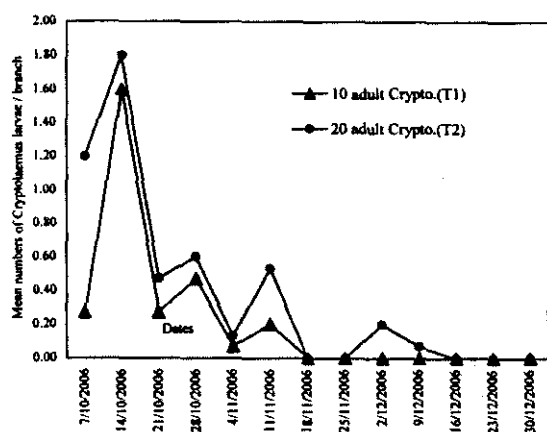


Fig. (5): Mean numbers of *Cryptolaemus* larvae per branch of *A. macrophylla* in the two treatments at Giza region, 2006.

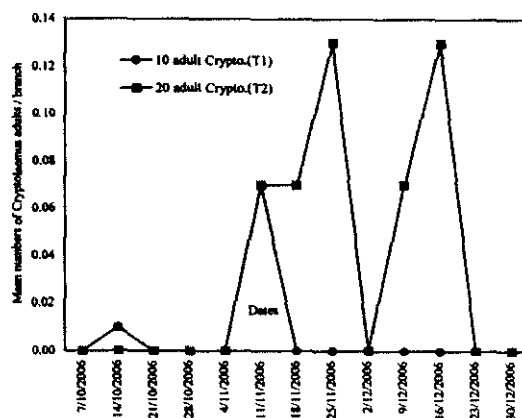


Fig. (6): Mean numbers of *Cryptolaemus* adults per branch of *A. macrophylla* in the two treatments at Giza region, 2006.

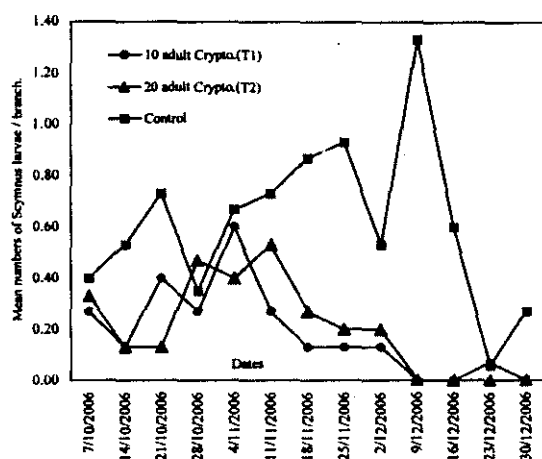


Fig. (7): Mean numbers of *Scymnus* larvae per branch of *A. macrophylla* in the two treatments and control at Giza region, 2006

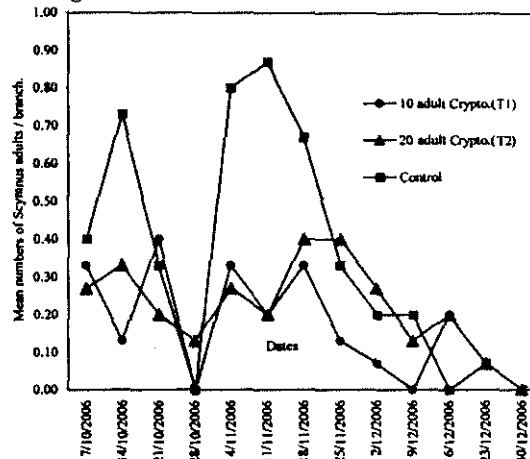


Fig. (8): Mean numbers of *Scymnus* adults per branch of *A. macrophylla* in the two treatments and control at Giza region, 2006

Cryptolaemus larvae showed insignificant differences between the two rates of release (T1 and T2). Recorded means were 0.2359, 0.3846 individuals/branch and the value of LSD 0.5% was 0.153 (Table 3).

2.2. *Cryptolaemus* adults

In the 6th week after release, *Cryptolaemus* adults started to appear with 0.07 ± 0.04 , 0.07 ± 0.02 individuals/branch recorded in T1 and T2, respectively. Afterwards, no individuals were recorded in T1 while a population ranged from 0.07 ± 0.02 and 0.13 ± 0.05 individuals/branch in T2 during the period from 11/11 until 16/12/2006 (Fig.6). It is important to mention, that the recorded counts of adults might be less than the actual numbers due to the adult flying or falling due to the movement of plant branches during inspection. Despite of the law counting of adults, were effective in reducing the population of the pest compared to the pest numbers in the control. Analysis of variance for the population of *Cryptolaemus* showed

significant differences between the two rates of release (Table 3). Recorded means were 0.0051, 0.0359 individuals/ branch in the T1 and T2, respectively, and the value of LSD 0.5% were 0.0258.

3. Effect of *Cryptolaemus* release

The coccinellid predator *Scymnus syriacus* (Mars.) was found feeding on the striped mealybug, *F. virgata* infesting *Acalypha* shrubs at Giza region. Results in figs. 7, 8 represent the effect of *Cryptolaemus* release on the population of *S. syriacus*.

3.1. On the larval population of *S. syriacus*

Results in fig.(7) showed that, during the 1st month after release (7/10/2006 to 28/10/2006), the population of *S. syriacus* larvae ranged from 0.13 ± 0.05 - 0.40 ± 0.16 , 0.13 ± 0.09 - 0.47 ± 0.19 in the T1, T2 respectively, and 0.35 ± 0.19 - 0.73 ± 0.25 individuals/branch in the control,. During the 2nd and 3rd months after release, the population ranged

0.13±0.05-0.60±0.33, 0.2±0.08-0.53±0.19 and 0.67±0.25-0.93±0.25 individuals/branch and 0.0-0.13±0.05, 0.0 - 0.2±0.08 and 0.6±0.25-1.33±0.34 individuals/branch in T1, T2 and the control, respectively.

Analysis of variance (Table 3) showed highly significant differences between each of the recorded means of T1, T2 and the control. Respective values were 0.1846, 0.2205 and 0.6718 individuals/ branch (LSD 0.5% was 0.1537).

3.2. On the adults' population of *S. syriacus*:

Results in Fig.(8) showed that, during the first month after release, the population of *S. syriacus* adults ranged from 0.0-0.4±0.14, 0.13±0.05-0.33±0.12 and 0.0 - 0.73±0.25 individuals/branch in T1, T2 and the control, respectively. During the 2nd and 3rd months the population ranged 0.13±0.05-0.33±0.05, 0.2±0.08 - 0.4±0.16 and 0.33±0.19-0.87±0.19 individuals/branch and 0.0-0.2±0.08, 0.07±0.02-0.27±0.09 and 0.0-0.2±0.08 individuals/branch in T1, T2 and control, respectively.

Analysis of variance for the mean numbers of *S. syriacus* adults in T1, T2 and control shrubs (Table 3) showed highly significant differences between each of the recorded means of both T1, T2 and the control (0.1692, 0.2205 against 0.3539 individuals/ branch), while insignificant differences existed between T1 and T2 when the value of LSD 0.5% was 0.1168.

From the previous results concerning the effect of *Cryptolaemus* release on the population of *S. syriacus*, it could be concluded that, the population of *Scymnus* decreased as a result of the release of *Cryptolaemus*, may be due to the competition between them. So, it is suitable to release the predator *Cryptolaemus* in the places that suffer from the absence of *S. syriacus*.

The newly reclaimed cultivated areas of vineyards suffer from the absence of the predators where the population of vine mealybug, *P. ficus* has increased and caused a great problem (Attia, 2003). Therefore, rearing and release of *C. montrouzieri* in the vineyards might help in regulating the population of the vine mealybugs.

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