

Comparative Studies on the Seasonal Activity of *Eublemma gayneri* (Roth.) and their Natural Enemies as a New Guest on Mango Trees in Neglected and Commercial Orchards

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ABSTRACT

In the present study, the semi-lopper worm (SLW), *Eublemma gayneri* (Roth.) (Lepidoptera: Noctuidae) was recorded attacking mango inflorescence for the first time in Egypt. It exhibited three peaks of seasonal abundance annually. The anthocord predator, *Orius* sp. was mainly associated with *E. gayneri* population during the both years of investigation. The obtained data during the two years of study revealed that the larvae of *E. gayneri* were found to be parasitized by only one endo-parasitoid species namely; *Wohlfahrtia* sp. (belonging to Order: Diptera, Family: Sarcophagidae). The parasitoid was recorded for the first time in Egypt on semi-lopper worm larvae. This parasitoid was recorded in the neglected orchard with relatively high numbers; while, it was rarely recorded in the commercial orchard. In addition, the anthocord predator, *Orius* sp. was mainly associated with *E. gayneri* population during the both years of investigation, especially in mango orchard without chemical treatments. Generally, the obtained results obviously illustrated that insecticides treatments exhibited an adverse effect on the parasitoid, *Wohlfahrtia* sp. and the predator, *Orius* sp. populations.

INTRODUCTION

Genus: *Eublemma* includes several insect species (about 40 species) distributed in different parts of the world (Zahiri *et al.*, 2012). These species can be divided into three groups depending on type of their feeding habits (Kumar and Ramamurthy, 2012). The first group is considered as insect pests, includes 21 species which infest several economic important crops in different countries. The second group is considered as predators, includes 16 species which predate scale insects and mealy bugs. The third group includes three species which have ability either phytophagous or entomophagous insects (Kalshoven, 1981). In Egypt, Amer and El-Torkey, 2017 reported that eighteen species (including *Eublemma gayneri* (Roth.)) were recorded in Genus: *Eublemma* (Fam: Erebidae) Superfamily Noctuoidea (Lepidoptera).

The semi lopper worm (SLW), *E. gayneri* larvae attack earhead of pearl millet and sorghum panicles in Sudan, Senegal, Cameroun, West Central Africa and India (Noveiller, 1969; Rawat *et al.*, 1970; Gahukar, 1993 and Ajayi *et al.*, 2001). In India, Rawat *et al.* (1970), reported that the loss in grain yield of the hybrid sorghum CSH-1 infested by the larvae of *E. gayneri* was estimated to be 18.26%. In Egypt, El-Sherbiny (1978) reported that the larvae of *E. gayneri* were rarely on castor oil plants feeding on leaves. According to El-Rawy (1999 and 2004) SLM females laid their eggs on maize silk and larvae feed on silks and kernels at the top of ears from maize.

In the present study, *E. gayneri* was recorded for the first time in Egypt infesting mango inflorescences. Mango, *Mangifera indica* L. is considered one of the most important fruit crops in Egypt. The total area of mango trees reached 240804 feddans (Ministry of Agriculture, 2014). Egypt produces about 232,000 tons of mango annually and exports 1500 tones (Haggag, 2010). Therefore, the present investigation aims to throw a light on the comparative seasonal activity of *E. gayneri* population and their natural enemies as a new guest on mango trees in both neglected and commercial orchards.

MATERIALS AND METHODS

Experimental orchards:

The experiments were conducted in both neglected (without chemical treatments) and commercial orchards.

Both orchards located at Shirben district, Dakahlia governorate, Egypt (each orchard about 2 feddans cultivated with mango trees (*Mangifera indica* L.). During the experimental period the commercial orchard was sprayed with polyramDF, Abamectin (1.8% EC). and pestban (48 % EC) during December-January. In addition to winter oil, oxychloro copper, micron sulfur powder and pestban (48 % EC) treatments, were also sprayed for controlling mango diseases.

Sampling procedure:

To estimate the seasonal activity of *Eublemma gayneri* (Roth.) and its associated natural enemies, five homogenous mango trees (in size and age) were randomly chosen in each orchard. Samples were started from the 8th of February (in 2016 and 2017) and continued till the 24th and 25th of October (2016 and 2017, respectively).

Samples were collected every week at two height levels (2.5 ±0.5 and 5.0 ±0.5 meters) above the ground. Each sample consisted of 20 inflorescences/level (4 inflorescences/tree collected from different sides (north, south, east and west) of the tree. The collected samples were kept in paper bags and then it was pulled up and taken to the laboratory for inspection by using a binocular microscope. Number of SLW larvae and pupae were counted and recorded.

The collected *E. gayneri* larvae and pupae of each sample were maintained in Petri-dishes (10 cm in diameter) containing pieces of moistened cotton wools till the emergence of the parasitoids. The emerged parasitoids were counted and identified in Plant Protection Research Institute, Agricultural Research Center. The average percentages of parasitism were calculated during the two successive seasons 2016 and 2017. Also, the predators associated with the collected samples were counted and recorded.

Statistical analysis:

By using the computer program of Costat Software (1999), correlation and regression analysis were done. In addition, Duncan's Multiple Range Test was also done by using one way ANOVA to estimate the Least Significant Difference (LSD) with the same computer program.

RESULTS

In the present investigation, the semi-lopper worm (SLW), *Eublemma gayneri* (Roth.) (Lepidoptera:

Noctuidae) was recorded attacking mango inflorescence for the first time in Egypt. SLW larvae were recorded only at the height of 5.0 ±0.5 meters, and not recorded at the height of 2.5 ±0.5 meters above the ground.

1. Population fluctuations of SLW in mango orchards:

To follow up the changes in the population of SLW on mango inflorescences, mean numbers of immature stages (larvae and pupae)/ inflorescence were weekly counted during 2016 and 2017 seasons in the neglected and commercial orchards.

In the first year (2016):

Data graphically illustrated in Figure (1a) showed that the average number of *E. gayneri* immature stages /inflorescence on mango trees in both neglected and commercial orchards during the 1st (lasted from February till the end of May) and 2nd (extending from June till October) blooming periods of the first year.

In the neglected orchard:

At the first blooming period, *E. gayneri* population had one period of seasonal abundance on mango trees. This period was recorded from the 7th of March till the 30th of May showing one peak of (15.6 individuals/ inflorescence) during April 18th. While, at the second blooming period *E. gayneri* population exhibited two periods of seasonal abundance. The first period was recorded from the 6th of June till the 8th of August showing one peak of 22.5 individuals /inflorescence on the 11th of July. The second period was recorded from the 8th of August till the 17th of October with one peak of seasonal abundance (22.4 individuals /inflorescence) on the 29th of August (Figure, 1a).

In the commercial orchard:

E. gayneri population approximately showed the similar trend of changes to those of the neglected orchard. The SLW population exhibited three peaks of seasonal abundance. The first peak was recorded during the first blooming period (9.2 individuals /inflorescence) on the 4th of April. The second and the third one were reported during the second blooming period on the 11th of July (11.3 individuals /inflorescence) and the 29th of August (11.4 individuals/inflorescence) (Figure,1a). The results represented in Figure (3) indicated that *E. gayneri* population size in the commercial orchard was approximately half of the size in neglected orchard.

In the second year (2017):

In the second year, changes of *E. gayneri* population showed the similar trend to those of the first year. However, the semi lopper worm exhibited three peaks of seasonal abundance in both neglected and commercial orchards (Figure, 1b). In neglected orchard, these peaks were recorded in the last week of April (8.5 individuals/inflorescence), the second week of July (24.4 individuals/inflorescence) and the fourth week of August (24.3 individuals/inflorescence). In the commercial orchard, these peaks were recorded on the 4th week of April (7.4 individuals/inflorescence), the 2nd week of July (11.6 individuals/inflorescence) and the 3rd week of August (12.3 individuals/inflorescence).

Data illustrated in Figure (2), showed that population density of SLW in the neglected orchard was approximately twice higher than that in commercial one. The general mean numbers of SLW larvae and pupae

/inflorescence all over the season were (14.4 and 7.4) and (12.4 and 6.6) in the neglected and commercial orchards during 2016 and 2017, respectively.

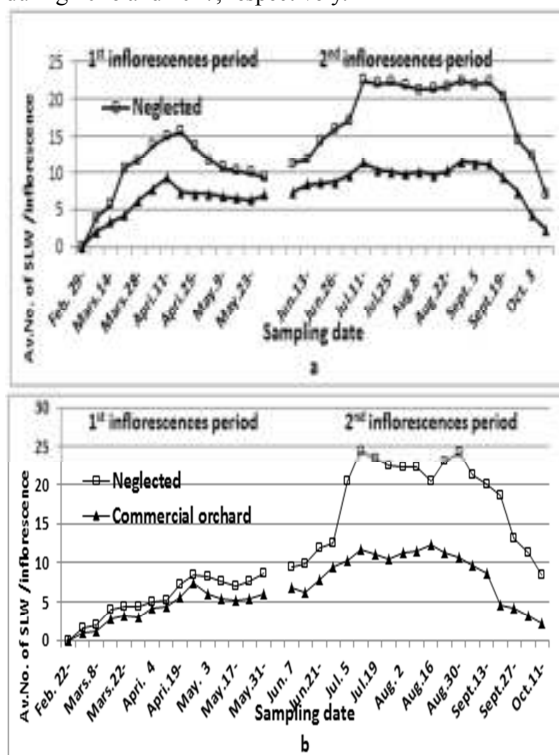


Figure 1a and b. Seasonal activity of the semi lopper worm (SLW) *Eublemma gayneri* (Roth.) population (larvae and pupae) on mango inflorescences in neglected and commercial orchards during 2016 (a) and 2017 (b) seasons.

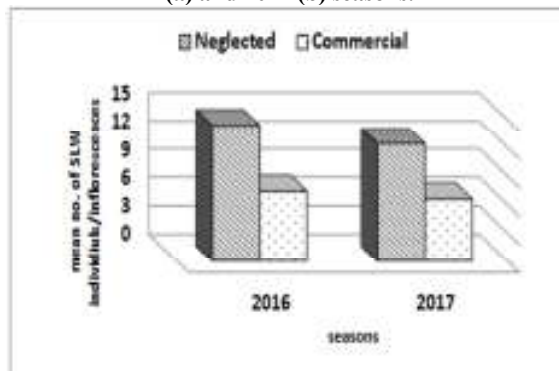


Figure.2. General mean number of SLW larvae/inflorescence all over 2016 and 2017 seasons in neglected and commercial orchards.

2. Natural enemies associated with mango inflorescences.

1. Insect predators:

During the course of study, three predaceous insect species were observed on the infested mango inflorescences associated with *E. gayneri*, namely *Orius* sp, *Geocoris ochropterus* and *Syrphus* sp. The anthocord predator, *Orius* sp was mainly associated with *E. gayneri* population during the both years of investigation.

Data presented in Table (1) showed that the monthly mean numbers of the anthocorid, *Orius* sp. during the first and second years of study (2016 and 2017) in both neglected and commercial orchards. From which it can be seen that *Orius* sp. population in the neglected orchard was twice higher than those in the commercial one. The highest population density of the predator was recorded in July with means of (3.6 & 4.8) and (1.6 and 1.6 individual/ inflorescence / week) during (2016 and 2017) in the neglected and commercial orchards, respectively.

Table 1. Monthly means of the anthocorid, *Orius* sp. /inflorescences /week in the neglected and commercial orchards during 2016 and 2017.

Month	Neglected		Commercial	
	2016	2017	2016	2017
March	1.0	1.0	0.5	0.4
April	1.3	2.3	0.9	1.7
May	1.4	2.3	1.0	1.7
June	2.9	3.4	1.3	1.2
July	3.6	4.8	1.6	1.6
August	1.7	2.8	1.3	1.2
September	2.1	2.2	1.4	0.9
October	1.0	0.5	0.2	0.3
General mean	1.9±0.9	2.4±1.3	1.0±0.5	1.1±0.6

From the statistical point of view, the total number of collected predator showed high significantly positive correlation with the average population density of the prey in the first and second years in the two orchards. The correlation coefficient values were 0.6** and 0.63** in the neglected orchards and 0.83** and 0.57** in the commercial orchards in the first and second years, respectively (Table, 2).

The simple regression for the effect of prey density on *Orius* sp. population in neglected orchard revealed a high significantly positive effect during the two seasons (b= 0.43 and 0.11). This means that, each increase of SLW population by one larva/ inflorescence increased the population of *Orius* sp. by 0.43 and 0.11 individuals/ inflorescence during the first and second seasons. While, in the commercial orchard statistical analysis showed that each increase of SLW population by one individual increased the population of *Orius* sp. by 0.15 and 0.08 individuals/ inflorescence only, during the first and second seasons (Table, 2).

Table 2. The relation between *Eulemma gayneri* (Roth.) and *Orius* sp. populations in both neglected and commercial orchards during 2016 and 2017.

Experimental orchard	Correlation and simple regression				
		r	b	P	R ²
Neglected	2016	0.60	0.43	0.0003	0.35
	2017	0.63	0.11	0.0001	0.39
Commercial	2016	0.83	0.15	0.0000	0.70
	2017	0.57	0.08	0.0004	0.32

2. Parasitoids:

The obtained data during the two years of study revealed that the larvae of *E. gayneri* were found to be parasitized by only one endo-parasitoid species namely; *Wohlfahrtia* sp. (belonging to Order: Diptera, Family: Sarcophagidae). The parasitoid was recorded for the first time in Egypt on SLW larvae infested mango

inflorescence. This parasitoid was recorded in the neglected orchard with relatively high numbers; while, it was rarely recorded in the commercial orchard and even then in a low number.

1. The relation between the parasitoid, *Wohlfahrtia* sp. population and the host density

As shown in Figure 3 (a and b), the visual correlation obviously indicated that the parasitoid population exhibited a good synchronization with the changes of host density. However, changes of parasitoid populations coincided with changes of the host density of SLW in both years of study. Statistical analysis indicated that there was high significantly positive correlation between SLW and the parasitoid populations during the first (r = 0.871**) and second (r = 0.76**) seasons. On another hand, each increase of SLW population by one larva/ inflorescence increased the population of *Wohlfahrtia* sp. by 0.14 and 0.09 individuals/ inflorescence during the first and second seasons. Also, statistical analysis showed that SLW population affected parasitoid population by 0.658 and 0.591 (as R2-values) during the first and second years.

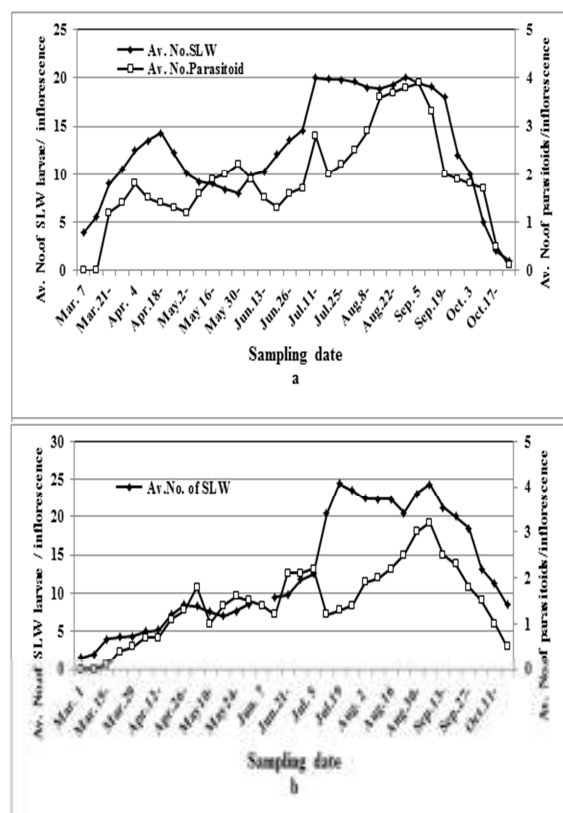


Figure 3 a and b. Synchronization between SLW larval population and its endo-parasitoid, *Wohlfahrtia* sp. in neglected mango orchard during 2016 (a) and 2017 (b).

2. Seasonal activity of the parasitoid, *Wohlfahrtia* sp. (parasitism %) on SLW larvae.

In the neglected orchard, the seasonal activity (as monthly parasitism %) of the parasitoid, *Wohlfahrtia* sp. on SLW larvae was illustrated in Table (3) for the first and second seasons. The obtained data in Table, 3 revealed that the highest activity of *Wohlfahrtia* sp. was recorded in May

in both years (2016 and 2017), represented by 16.7% and 18.5%, respectively, while, the lowest was (5.9 and 6.0%) recorded during March, respectively. The general mean of parasitism% all over the season averaged 11.9 ± 3.2 and $12.6 \pm 4.4\%$ during the first and second years.

In the commercial orchard, the parasitoid was rarely observed with few individuals during June and July, represented by one and two individuals on all collected samples.

Table 3. Monthly mean of parasitism percentages of the endo-parasitoid, *Wohlfahrtia* sp. on SLW larvae infesting mango inflorescence in neglected orchard during seasons of 2016 and 2017.

Month	Neglected orchard	
	2016	2017
March	5.9	6
April	10.3	16.1
May	16.7	18.5
June	12.3	15.6
July	9.6	7.1
August	14.5	10.4
September	13.8	13.4
October	12.2	13.8
General mean \pm SD	11.9 ± 3.2	12.6 ± 4.4

In general, the obtained results obviously cleared that the general mean of *E. gayneri* population was twice high on mango trees in the neglected orchard (14.4 ± 6.5 and 12.4 ± 7.8 individuals) in comparison with those in the commercial orchard (7.4 ± 3.0 and 6.6 ± 3.6 individuals/inflorescence /week). On the contrary, the general mean density of *Orius* sp. population all over the year in the neglected was (1.9 ± 0.9 and 2.4 ± 1.3 individuals) twice higher than those in the commercial orchard (1.0 ± 0.5 and 1.1 ± 0.6 individuals/ inflorescence /week) during 2016 and 2017, respectively. Moreover, the average percentage of parasitism on *E. gayneri* population in the commercial orchard was considerably low approach to zero in comparison with those in the neglected orchard 11.9 ± 3.2 and 12.6 ± 4.4 (in the first and second years).

DISCUSSION

Data obtained revealed that, the semi-lopper worm (SLW), *Eublemma gayneri* (Roth.) (Lepidoptera: Noctuidae) was recorded attacking mango inflorescence for the first time in Egypt Also, it considered as crops pest attacking three hosts: maize, sorghum and castor oil plants in certain governorates of Middle and Upper Egypt (El-Rawy (1999, 2004)). It was recorded with relatively high abundance on maize and sorghum (El-Rawy, 2004) and rarely on castor oil plants (El-Sherbiny, 1978). In Senegal, Gahukar (1993) found that twelve sorghum cultivars significantly differed in the degree of attack by *E. gayneri*. There was a positive correlation between panicles and pest infestation levels, cultivars having compact panicles had denser population density of *E. gayneri* larvae than those with loose panicles. Ajayi et al., (2001) mentioned that *E. gayneri* among the major panicle-feeding insect pests damaging sorghum panicle in the areas surveyed (at Kamboinse, Burkina Faso, and ICSV 247 at Bagauda, Nigeria).

The SLW population exhibited three peaks of seasonal abundance during April, July and August. The highest occurrence of *E. gayneri* was in August in both years of study. Similar results was obtained by El-Sherbiny

(1978), who reported *E. gayneri* inhabiting castor oil plants during the period from June to November. According to El-

Rawy (2004), ears of maize were attacked during the blister stage and continued until the physiological maturing stage. The highest abundance of larvae and pupae were recorded during the dough stage (from September - October).

In the present study the anthocorid *Orius* sp. population was associated with the lepidopteran species, *E. gayneri* all over the period of investigation. Several authors demonstrated that *Orius* spp. proved to be an efficient predator against some lepidopteran species (Bugg and Wilson, (1989); Mansour, 2004; EL-Barbary, (2006) and Abd El-Kareim et al., 2008). Egg masses of both lepidopterous species *Spodoptera exigua* (Hubner) and *Piatynota stultana* Walshingham are known to be attacked by generalist predators, including *Orius* (Eveleens et al., 1973).

Data obtained during the two successive years indicated that the *E. gayneri* larvae attacked by the parasitoid, *Wohlfahrtia* sp. as a first record. According to Hara et al. (1999) the genera, *Wohlfahrtia* are a parasitic species on insects in rangeland habitats, including the sarcophagid, *Wohlfahrtia vigil* (Walker) (Bugg and Wilson, 1989). Povolny and Verves (1990) reported that *Sarcophaga emdeni* (Rohdendorf) is a parasitoid of lepidopteran larvae.

The obtained results obviously illustrated that insecticides treatments exhibited an adverse effect on the parasitoid, *Wohlfahrtia* sp. and the predator, *Orius* sp. populations. Similar conclusion was obtained by Mansour (2004) and Abd El-Kareim et al., (2008) where insecticide treatments significantly reduced the efficiency of the parasitoids and predators (including *Orius* spp.) associated with the lepidopteran species (*Pectinophora gossypiella* Saunders and *Earias insulana* Boisduval).

Because of the chemical treatments caused about 50% reduction of the predator, in addition there was no chance for the parasitoid, activity all over the period of investigation. So, it could be concluded that the use of another control methods rather than chemical treatment beside the natural enemies may be an efficient solution for controlling the semi looper worm in mango orchard. Similar conclusion was obtained by Abd El-Kareim et al., (2008).

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دراسات مقارنة على النشاط الموسمي ل *Eublemma gayneri* (Roth.) وأعدائها الطبيعية كضيف جديد على أشجار المانجو في البساتين المهملة والمعاملة

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في الدراسة الحالية تم تسجيل الدودة النصف قياسية *Eublemma gayneri* التابعة لرتبة حرشفية الاجنحة لأول مرة على الشماريخ الزهرية للمانجو في مصر. كما تم تسجيل *Orius* sp. التابع لرتبة نصفية الاجنحة كمفترس رئيسي مرتبط بهذه الآفة، وأظهر المفترس ثلاث ذروات للنشاط خلال موسمي الدراسة. أوضحت النتائج خلال عامي الدراسة أن نوع واحد فقط من الطفيليات الداخلية تم تسجيله على يرقات *E. gayneri* يطلق عليه؛ *Wohlfahrtia* sp. (ينتمي إلى رتبة، ذات الجناحين، العائلة: Sarcophagidae). تم تسجيل هذا الطفيل في المزرعة المهملة بأعداد كبيرة نسبياً. بينما كان من النادر تسجيله في المزرعة المعاملة. بشكل عام، أظهرت النتائج التي تم الحصول عليها بوضوح أن معاملات المبيدات الحشرية أظهرت تأثيراً سلبياً على تعداد كلاً من الطفيل *Wohlfahrtia* sp. والمفترس *Orius* sp.