

## BIONOMICS OF THE GUAVA SOFT SCALE INSECT, *PULVINARIA PSIDII* (MASKELL) (HEMIPTERA : COCCIDAE) IN EGYPT

MONA MOUSTAFA AND SHAABAN ABD-RABOU

Plant Protection Research Institute, ARC, Dokki, Giza

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### Abstract

The guava soft scale insect, *Pulvinaria psidii* (Maskell) (Hemiptera : Coccidae) is considered one of the most important pest infesting guava in Egypt. The aim of this work is to study the survey of host plants, geographical distribution and natural enemies of the guava soft scale insect, *P. psidii* in Egypt as well as the biological studies of the guava soft scale, on guava, grape and mango. The obtained results indicated that the guava soft scale insect infested 8 plant species belonging to 5 genera in 5 families, distributed in 9 governorates. Eleven species of parasitoids were collected and recorded. Also seven species of predators were recorded attacked *P. psidii*. Temperatures greatly influenced the development of *P. psidii*. The lowering of the temperature increased the dimension of the soft scale insect and prolonged the developmental period. The results on guava, grape and mango showed that the life cycle of *P. psidii* at 30°C were  $67.0 \pm 0.79$ ,  $67.0 \pm 7.88$  and  $79.8 \pm 1.95$  days, respectively. These results indicated that *P. psidii* prefers guava, followed by grape and mango.

### INTRODUCTION

The guava soft scale insect, *Pulvinaria psidii* (Maskell) (Hemiptera : Coccidae) attacks a large number of economic crops (Elmer & Brawner, 1975 and El-Minshawy & Moursi (1985)). In Egypt, it is attacking 6 host plant species including citrus, guava and mango (Mohammad & Nada, 1991 and Hendawy, 1999). The guava soft scale insect feeds on the phloem and is generally found on leaves and tender young stems of the host plant. Damage due to the feeding of an individual scale is small. However, large feeding populations can cause yellowing, defoliation, reduction in fruit set, and loss in plant vigor. It excretes honeydew. The honeydew serves as a medium on which a sooty fungus, called sooty mold, grows. Sooty mold blackens the leaf, decreases photosynthesis activity, and decreases vigor of the host. When the sooty mold occurs on fruit, it often becomes unmarketable or of a lower grade, because the fungus affects the appearance of the fruit and is difficult to wash off (Elmer and Brawner, 1975).

Later El-Serafi *et al.* (2004) stated that *P. psidii* one of the most important pest infesting guava in Egypt. Different studies of the guava soft scale insect have been recorded by Salama and Salem, 1970 (seasonal abundance); Abd-Rabou and Attia,

2006a,b , Moursi ,1974 ( parasitoids), Hendaway, 1999 ( parasitoids and predators) and El-Minshawy and Moursi (1985) ( biological studies).

The aim of this work is to study the survey of host plants, geographical distribution and natural enemies of the guava soft scale insect, *P. psidii* in Egypt as well as the biological aspects of this pest on guava, grape and mango at different temperatures.

## MATERIALS AND METHODS

### 1. Host plants and distribution of the guava soft scale insect, *Pulvinaria psidii*

Infested plants were examined in the field using a pocket magnification lens. Infested leaves, flowers or fruiting structures were collected from different host plants and different locations in Egypt during 2008-2009. Identification of guava soft scale insect was done by examining adults in Canada Balsam.

### 2. Natural enemies of the guava soft scale insect, *Pulvinaria psidii*

Infested crops with the different pests will be examined in the field, using a pocket lens. The parts of the plant from different crops will be collected and placed separately in paper bags for further examination in the laboratory.. Materials will be kept in a well-ventilated container until the emergence of any natural enemies. Identification of natural enemies will be made by examining mounted adults in Hoyers medium and on card as follows:

**Preservation:** The specimens of natural enemies are best preserved as slide mounts and card . It may not be possible to see all the characters and measure some structures in carded specimens. However, when more specimens are available, it is preferable to have both slide mounted and carded specimens. Since body colour is likely to fade during clearing process, it might be necessary to note the colour and sculpture either from dried or freshly collected specimens preserved in alcohol. The smaller size of the specimens and their soft, less sclerotized bodies, make the specimens almost useless for study if preserved in alcohol for longer periods.

**The procedures of slide mounts as follows:** Dried specimens are soaked in glacial acetic acid (7 drops) mixed with chloral phenol (5 drops) in small watch glasses.

- a. After 48 hours specimens should be satisfactorily cleared.
- b. The cleared specimens are then mounted in Hoyer's medium.

After drying for about two weeks under 40 °C, the slide cover is ringed with a suitable sealer.

The specimens identified and confirmed by the second author and Dr. Gerg Evans, USDA, USA.

### **3. Biological studies of the guava soft scale insect, *Pulvinaria psidii***

The guava soft scale insect, *P. psidii* was reared on three host plants i.e. guava, grape and mango . For biological studies of *P. psidii* eggs and crawlers were obtained from mother soft scale reared on guava, grape and mango under laboratory conditions 25-27°C, 65-75% RH and 18 hours Photoperiod. The incubation period of eggs was determined by using one day old egg of a mother soft scale. Fifty eggs from each host plant were spread on blotting paper in a small Petri dish. This Petri dish was in turn placed within a bigger dish containing some distilled water. The latter dish was covered with fine muslin so as to give maximum humidity to the eggs. The Petri dish containing the eggs was kept in a constant temperature incubator. Ten replicate Petri dish for each plant were kept at the following temperatures: 18°C, 24°C and 30°C. The procedure for determining egg viability was, similar to that of egg incubation. Fifty eggs from each host plant were kept in each Petri dish at the following temperatures: 18°C, 24°C and 30°C. Four replicate of Petri dish for host each were kept at each temperature regime. The eggs were observed daily with a stereomicroscope (X 15) for the emergence of the crawlers. For studying the development of the soft scale, guava, grape and mango washed with clean water. Newly emerged crawlers were transferred from the mother scale on to the leaves of guava, grape and mango using a fine paint brush. Each pot was infested with 100 crawlers. The infested pot was then kept in a ventilated polystyrene box (175 mm X 115 mm X 52mm). Two boxes were kept at each of the temperatures used in the study. Twenty individual soft scale exposed at each of the various constant temperatures were selected at random for studying their development. The development of the individual soft scale was observed daily using a stereomicroscope (x 15).

The obtained data of the biological studies were analyzed following Birch (1948) using Life 48 Basic Computer Program (Abou-Setta *et al.*, 1986). Sex ratio was considered (since all progeny developed to females).

## **RESULTS AND DISCUSSION**

### **1. Host plants of the guava soft scale insect, *Pulvinaria psidii***

The guava soft scale insect infested 8 plant species belonging to 5 genera in 5 families in Egypt (Table, 1). Salama and Salem (1970) and Osman *et al.* (1982) recorded *P. psidii* on *Aralia longifolia* shrubs causing a great damage. Moursi (1974) recorded *P. psidii* infested *Aralia papyrifera*. El-Minshawy and Moursi (1985) ,

Hendawy (1999) and El- Serafi *et al.* (2004) stated that *P. psidii* infested guava in Egypt.

## **2. Geographical distribution of the guava soft scale insect, *Pulvinaria psidii***

This soft scale species distributed in 9 governorates ( Map, 1). These governorates are Alexandria, Behira, Cairo, Daqhilya, Gharbiya, Giza, Ismailia, Kafer El-Shikh, Qalyubiya and Sharqiya.

## **3. Natural enemies of the guava soft scale insect, *Pulvinaria psidii***

### **3.1. Parasitoids**

Eleven species of aphelinids, encyrtids, eulophid and pteromalid were collected and recorded from concerned specimen under investigation (Table,2). In this respect Moursi (1974) stated that *P. psidii* was attacked by the parasitoids, *D. elegans* and *Aminellus* sp. on guava trees in Alexandria. Hendaway (1999) mentioned that, *Encarsia* sp. parasitize *P. psidii* nymphs. He added that *P. psidii* adults parasitized by *M. flavus*, *D. elegans*, *Mi. flavus* and *T. ceroplastae*.

### **3.2. Predators**

Seven species of predators were recorded attacked *P. psidii*. These species belonging to 4 species in Coleoptera, one species in Hemiptera, and two species in Neuroptera (Table, 3). No country side work was conducted on the predators of guava soft scale insect.

## **4. Biological studies of the guava soft scale insect, *Pulvinaria psidii* under different host plants and temperatures**

### **4.1. Biological studies of the guava soft scale insect, *Pulvinaria psidii* on guava trees**

The biological and life table parameters of the guava soft scale, *P. psidii* at three different constant temperatures (i.e. 18, 24 and 30°C) on guava are presented in Table ( 4 ). Mean durations of the first instar were 23.4±1.17, 14.7±1.25 and 11.1±0.74 days at 18, 24 and 30°C, respectively. Second instar lasted for 33.8±1.32, 26.2±1.03 and 18.2±0.79 days, respectively. While third instar durations were 42.1±1.20, 34.6±0.97 and 27.5±0.85, respectively. Incubation periods were 21.8±0.79, 17.1±0.88 and 10.2±0.79 days, respectively. The generation period was 121.7±1.01, 92.6±0.98 and 67.0±0.79 days, respectively. The durations of the adult longevity were 51.1±1.20, 43.2±1.23 and 33.4± 1.17 days, respectively (Table,5) . These results indicated that 30°C was the most adequate tested temperature for the guava soft scale insect, *P. psidii* life resulting the highest oviposition (222.3±2.16 eggs/female), the shortest incubation period (10.2±0.79 days) and adult longevity (33.4±1.17 days).

#### **4.2. Biological studies of the guava soft scale insect, *Pulvinaria psidii* on mango trees**

The biological and life table parameters of the guava soft scale insect, *P. psidii* at three different constant temperatures (i.e. 18, 24 and 30°C) on mango trees are presented in Table ( 6 ). Mean durations of the first instar were  $26.9 \pm 0.70$ ,  $18.0 \pm 0.70$  and  $14.8 \pm 0.80$  days at 18, 24 and 30°C, respectively. Second instar lasted for  $38.0 \pm 0.8$ ,  $28.5 \pm 0.50$  and  $21.0 \pm 0.70$  days, respectively. While third instar durations were  $45.7 \pm 0.70$ ,  $38.3 \pm 0.70$  and  $31.0 \pm 0.80$ , respectively. Incubation periods lasted  $24.7 \pm 0.70$ ,  $20.0 \pm 0.90$  and  $13.0 \pm 0.80$  days, respectively. The generation period was  $135.3 \pm 2.04$ ,  $104.8 \pm 1.98$  and  $79.8 \pm 1.95$  days, respectively. The durations of the adult longevity were  $55.1 \pm 0.74$ ,  $47.3 \pm 1.34$  and  $37.1 \pm 0.74$  days, respectively (Table,7) . These results indicated that 30°C was the most adequate tested temperature for the guava soft scale insect, *P. psidii* showing the highest oviposition ( $205.7 \pm 3.80$  eggs/female), the shortest incubation period ( $4.5 \pm 0.53$  days) and adult longevity ( $8.4 \pm 0.21$  days).

#### **4.3. Biological studies of the guava soft scale insect, *Pulvinaria psidii* on grape trees**

The biological and life table parameters of the guava soft scale insect, *P. psidii* at three different constant temperatures (i.e. 18, 24 and 30°C) on grape are presented in Table ( 8 ). Mean durations of the first instar were  $31.8 \pm 1.03$ ,  $23.1 \pm 0.74$  and  $20.2 \pm 1.23$  days at 18, 24 and 30°C, respectively. Second instar lasted  $42.5 \pm 0.97$ ,  $33.1 \pm 0.88$  and  $26.4 \pm 2.72$  days, respectively. While third instar durations were  $49.5 \pm 1.27$ ,  $43.9 \pm 1.10$  and  $34.9 \pm 0.88$ , respectively. Incubation periods were  $28.2 \pm 0.79$ ,  $23.7 \pm 0.95$  and  $17.0 \pm 0.94$  days, respectively. The generation period was  $121.7 \pm 9.78$ ,  $92.6 \pm 9.77$  and  $67.0 \pm 7.88$  days, respectively. The durations of the adult longevity were  $58.6 \pm 0.70$ ,  $53.0 \pm 0.94$  and  $42.0 \pm 0.82$  days, respectively (Table,9) . These results indicated that 30°C was the most adequate tested temperature for the guava soft scale insect, *P. psidii* life showing the highest oviposition ( $188.1 \pm 2.47$  eggs/female), the shortest incubation period ( $17.0 \pm 0.94$  days) and adult longevity ( $42.0 \pm 0.82$  days).

In the present work, the host plants and temperatures greatly influenced the development of *P. psidii*. The lowering of the temperature increased the dimension of the soft scale and lengthened the development period. The results on guava, grape and mango trees showed that the life cycle of *P. psidii* at 30°C were  $67.0 \pm 0.79$ ,  $79.8 \pm 1.95$  and  $67.0 \pm 7.88$  days, respectively. These results indicated that *P. psidii* prefers guava, grape and mango trees, respectively. El-Minshawy and Moursi (1985) stated that the egg stage of *P. psidii* hatched after 11 to 28 days. The adult female

deposits 200.4 eggs as an average. The whole life cycle lasted from 180 to 210 during the reared broad in winter.

Table 1. Host plants of the guava soft scale insect, *P. psidii* in Egypt.

Species	Host plant	Family
<i>Pulvinaria psidii</i>	<i>Aralia longifolia</i>	Araliaceae
	<i>Aralia papyrifera</i>	Araliaceae
	<i>Citrus</i> sp.	Rutaceae
	<i>Ficus benghalensis</i>	Moraceae
	<i>Ficus cunninghamii</i>	Moraceae
	<i>Ficus trijuja</i>	Moraceae
	<i>Mangifera indica</i>	Anacardiaceae
	<i>Pisidium gujava</i>	Myrtaceae

Table 2. Parasitoids of the guava soft scale insect, *P. psidii* in Egypt.

Host mealybugs	Parasitoids	
	Family	Species
<i>P. psidii</i>	Aphelinidae	<i>Coccophagus scutellaris</i> (Dalman)
		<i>Marietta leopardina</i> Motschulsky
	Encyrtidae	<i>Cowperia</i> sp.
		<i>Diversinervus elegans</i> Silvestri
		<i>Metaphycus annecki</i> Guerrieri and Noyes
		<i>M. flavus</i> (Howard)
		<i>M. helvolus</i> (Compere)
		<i>M. lounsburyi</i> (Howard)
	Eulophidae	<i>Microterys flavus</i> (Howard)
		<i>Tetrasticus ceroplastae</i>
	Pteromalidae	<i>Scutellista caerulea</i> (Fonscolombe)

Table 3. Predators of the guava soft scale insect , *P. psidii* in Egypt.

Host soft scale	Predators		
	Order	Family	Species
<i>P. psidii</i>	Coleoptera	Coccinellidae	<i>Chilocorus bipustulatus</i> L.
			<i>Exochomus flavipes</i> Thunb.
			<i>Scymnus interruptus</i> Goeze
			<i>Scymnus seriacus</i> Mars.
	Hemiptera	Anthocoridae	<i>Orius laevigatus</i> Fieb.
	Neuroptera	Chrysopidae	<i>Chrysoperilla carnae</i> Steph.
			<i>Chrysopa vulgaris aegyptica</i> (Schneider)



Table 5. Average duration (in days) of adult period (female) of the guava soft scale insect, *Pulvinaria psidii* Maskell and number of eggs laid by the adult females on guava plants at different constant temperatures (18, 24 and 30°C).

Developmental stages	Duration (in days)					
	Mean $\pm$ SD at 18°C		Mean $\pm$ SD at 24°C		Mean $\pm$ SD at 30°C	
	Female	Eggs/ Female	Female	Eggs/ female	Female	Eggs/ Female
<b>Pre-oviposition</b>	6.2 $\pm$ 0.13	-	4.8 $\pm$ 0.24	-	3.7 $\pm$ 0.34	-
<b>Oviposition</b>	13.24 $\pm$ 0.38	-	11.23 $\pm$ 0.56	-	9.33 $\pm$ 0.56	-
<b>Post-oviposition</b>	3.8 $\pm$ 0.21	-	2.2 $\pm$ 0.44	-	1.9 $\pm$ 0.36	-
<b>Longevity</b>	51.1 $\pm$ 1.20	176.6 $\pm$ 2.76	43.2 $\pm$ 1.23	193.4 $\pm$ 5.04	33.4 $\pm$ 1.17	222.3 $\pm$ 2.16
<b>Adult's life span</b>	74.3 $\pm$ 2.02	-	61.4 $\pm$ 1.89	-	48.3 $\pm$ 1.04	-

Table 6. Average duration (in days) of the guava soft scale insect, *Pulvinaria psidii* Maskell stages on mango plants at different constant temperatures (18, 24 and 30°C).

Developmental stages	Duration (in days)		
	Mean $\pm$ SE at 18°C	Mean $\pm$ SE at 24°C	Mean $\pm$ SE at 30°C
<b>Egg incubation period</b>	24.7 $\pm$ 0.70	20.0 $\pm$ 0.90	13.0 $\pm$ 0.80
<b>1<sup>st</sup> stage</b>	26.9 $\pm$ 0.70	18.0 $\pm$ 0.70	14.8 $\pm$ 0.80
<b>2<sup>nd</sup> stage</b>	38.0 $\pm$ 0.8	28.5 $\pm$ 0.50	21.0 $\pm$ 0.70
<b>3<sup>rd</sup> stage</b>	45.7 $\pm$ 0.70	38.3 $\pm$ 0.70	31.0 $\pm$ 0.80
<b>Total nymphal period</b>	110.6 $\pm$ 0.06	84.8 $\pm$ 0.12	66.8 $\pm$ 0.06
<b>Pre-oviposition period</b>	6.6 $\pm$ 0.45	4.9 $\pm$ 0.65	3.5 $\pm$ 0.12
<b>Oviposition period</b>	14.13 $\pm$ 0.76	12.10 $\pm$ 0.32	9.87 $\pm$ 0.32
<b>Post-oviposition period</b>	3.9 $\pm$ 0.43	2.8 $\pm$ 0.65	2.1 $\pm$ 0.43
<b>Total average of eggs/female (fecundity)</b>	163.4 $\pm$ 2.00	177.4 $\pm$ 2.10	205.7 $\pm$ 3.80
<b>Life cycle</b>	135.3 $\pm$ 2.04	104.8 $\pm$ 1.98	79.8 $\pm$ 1.95



Table 7. Average duration (in days) of adult period (female) of the guava soft scale insect, *Pulvinaria psidii* Maskell and number of eggs laid by the adult females on mango plants at different constant temperatures (18, 24 and 30°C).

Developmental stages	Duration (in days)					
	Mean $\pm$ SD at 18°C		Mean $\pm$ SD at 24°C		Mean $\pm$ SD at 30°C	
	Female	Eggs/ Female	Female	Eggs/ female	Female	Eggs/ Female
Pre-oviposition	6.6 $\pm$ 0.45	-	4.9 $\pm$ 0.65	-	3.5 $\pm$ 0.12	-
Oviposition	14.13 $\pm$ 0.76	-	12.10 $\pm$ 0.32	-	9.87 $\pm$ 0.32	-
Post-oviposition	3.9 $\pm$ 0.43	-	2.8 $\pm$ 0.65	-	2.1 $\pm$ 0.43	-
Longevity	55.1 $\pm$ 0.74	163.4 $\pm$ 2.00	47.3 $\pm$ 1.34	177.4 $\pm$ 2.10	37.1 $\pm$ 0.74	205.7 $\pm$ 3.80
Adult's life span	79.7 $\pm$ 2.34	-	67.1 $\pm$ 2.13	-	52.6 $\pm$ 2.45	-

Table 8. Average duration (in days) of the guava soft scale insect, *Pulvinaria psidii* Maskell stages on grape vine plants at different constant temperatures (18, 24 and 30°C).

Developmental stages	Duration (in days)		
	Mean $\pm$ SE at 18°C	Mean $\pm$ SE at 24°C	Mean $\pm$ SE at 30°C
Egg incubation period	28.2 $\pm$ 0.79	23.7 $\pm$ 0.95	17.0 $\pm$ 0.94
1 <sup>st</sup> stage	31.8 $\pm$ 1.03	23.1 $\pm$ 0.74	20.2 $\pm$ 1.23
2 <sup>nd</sup> stage	42.5 $\pm$ 0.97	33.1 $\pm$ 0.88	26.4 $\pm$ 2.72
3 <sup>rd</sup> stage	49.5 $\pm$ 1.27	43.9 $\pm$ 1.10	34.9 $\pm$ 0.88
Total nymphal period	123.80 $\pm$ 8.91	100.10 $\pm$ 10.40	81.50 $\pm$ 7.38
Pre-oviposition period	8.4 $\pm$ 0.21	6.9 $\pm$ 0.65	5.2 $\pm$ 0.78
Oviposition period	15.8 $\pm$ 0.76	13.72 $\pm$ 0.65	10.6 $\pm$ 0.75
Post-oviposition period	5.7 $\pm$ 0.65	3.56 $\pm$ 0.74	2.6 $\pm$ 0.55
Total average of eggs/female (fecundity)	153.3 $\pm$ 1.89	162.1 $\pm$ 2.02	188.1 $\pm$ 2.47
Life cycle	121.7 $\pm$ 9.78	92.6 $\pm$ 9.77	67.0 $\pm$ 7.88

Table 9. Average duration (in days) of adult period (female) of the guava soft scale insect, *Pulvinaria psidii* Maskell and number of eggs laid by the adult females on grape vine plants at different constant temperatures (18, 24 and 30°C).

Developmental stages	Duration (in days)					
	Mean $\pm$ SD at 18°C		Mean $\pm$ SD at 24°C		Mean $\pm$ SD at 30°C	
	Female	Eggs/ Female	Female	Eggs/ female	Female	Eggs/ Female
Pre-oviposition	8.4 $\pm$ 0.21	-	6.9 $\pm$ 0.65	-	5.2 $\pm$ 0.78	-
Oviposition	15.8 $\pm$ 0.76	-	13.72 $\pm$ 0.6 5	-	10.6 $\pm$ 0.75	-
Post-oviposition	5.7 $\pm$ 0.65	-	3.56 $\pm$ 0.74	-	2.6 $\pm$ 0.55	-
Longevity	58.6 $\pm$ 0.70	153.3 $\pm$ 1.8 9	53.0 $\pm$ 0.94	162.1 $\pm$ 2.0 2	42.0 $\pm$ 0.82	188.1 $\pm$ 2.4 7
Adult's life span	88.5 $\pm$ 2.23	-	77.2 $\pm$ 3.24	-	60.4 $\pm$ 3.25	-

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منى مصطفى ، شعبان عبد ربه

معهد بحوث وقاية النباتات - مركز البحوث الزراعية- الدقى- الجيزة

حشرة الجوافة القشرية الرخوة من أهم الآفات التى تصيب الجوافة فى مصر والعالم . تم فى هذا العمل دراسة العوائل النباتية و التوزيع الجغرافى و الأعداء الحيوية والدراسات البيولوجية لحشرة الجوافة القشرية الرخوة فى مصر . وقد أشارت النتائج أن حشرة الجوافة القشرية الرخوة تصيب ثمانية عوائل نباتية ممثلة فى خمسة فصائل تابعة لخمسة أجناس و تنتشر هذه الآفة فى تسعة محافظات وتهاجم ب 11 طفيل تم تسجيل احد هذه الأنواع لأول مرة فى مصر وكما تم أيضا تسجيل 7 مفترسات مصاحبة لهذه الآفة . ومن النتائج أيضا أتضح أن أختلاف درجة الحرارة و العائل النباتى يؤثر تأثيرا بالغا على تطور حشرة الجوافة القشرية الرخوة . ومن خلال النتائج أيضا أتضح أن دورة حياة الحشرة على ثلاث نباتات (الجوافه والمانجو و العنب) عند درجة مئوية ٣٠ كانت  $67,0 \pm 0,79$  ،  $67,0 \pm 7,88$  و  $79,8 \pm 1,95$  أيام على الترتيب ومن هنا يتضح ان حشرة الجوافة القشرية الرخوة تفضل الجوافة عن العنب ثم المانجو.