

BIOLOGICAL STUDIES ON THE MEALYBUG *Icerya seychellarum*
(Westwood) (Homoptera, Margarodidae)
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ABSTRACT

The biology of the mealybug *I. seychellarum* was studied under field and laboratory conditions. The insect passed through 4 generations/year. Males are not existed so parthenogenesis is the only way of reproduction. The average of eggs laid per female was 46.7 ± 2.7 . Females fed on mango fruit laid more eggs than those fed on branches or leaves. Eggs incubated at 35°C and 90% R.H. did not hatch. Eggs incubated at 35°C with 70% R.H. hatched earlier than those at $15.0 \pm 1.0^{\circ}\text{C}$ with 90% R.H. with average duration 5.2 ± 0.2 and 18.2 ± 1.2 days, respectively. The nymphal stage duration was 25.2 ± 1.8 days during summer and 42.8 ± 1.8 days during winter at 33.0 ± 1.0 with 50% R.H. and $15.0 \pm 1.0^{\circ}\text{C}$ with 60% R.H, respectively. In Spring and Autumn this duration was 38.4 ± 2.1 and 33.4 ± 2.4 days at $21.0 \pm 1.0^{\circ}\text{C}$ with 55% R.H. and $27.0 \pm 1.0^{\circ}\text{C}$ with 70% R.H. respectively. Shortest preoviposition, oviposition and postoviposition periods were 8.6 ± 0.3 , 7.6 ± 1.2 and 9.6 ± 0.2 days, respectively during Summer at $33.0 \pm 1.0^{\circ}\text{C}$ with 50% R.H., while these durations prolonged during Winter being 22.3 ± 0.6 , 13.3 ± 1.7 and 16.5 ± 1.7 days, respectively. In Spring averages of these duration were 14.6 ± 0.8 , 10.8 ± 0.5 and 14.1 ± 1.4 days, respectively, while averaged 10.5 ± 0.5 , 9.7 ± 0.6 and 13.5 ± 1.1 days during Autumn. Female longevity averaged 25.8 ± 1.7 and 52.1 ± 3.2 days in Summer and Winter, respectively. The life-cycle lasted for 55.2 ± 3.7 and 107.4 ± 5.4 days in Summer and Winter, respectively while averaged 87.7 ± 5.0 and 74.8 ± 4.5 days in Spring and Autumn.

Key words: Biology; Mealy bug; *Icerya seychellarum*; Homoptera.

INTRODUCTION

The wide spread cultivation of mango in the new reclaimed desert land helped the wide spread of the mealybug *I. seychellarum* especially due the prevalent favorable climatic condition. This insect attacks leaves, new branches, and fruits causing chlorotic appearance, dryness of the infested areas thus producing poor quality fruits. The insect was recorded in Egypt by **Brizi (1935) and Ezz& Samhan (1965)**. And was found on mango trees by **Assem (1990)**. **Ali (1980)** studied some biological aspects of this pest by rearing on either palm leaves or sprouting potatoes at laboratory conditions ($17-28^{\circ}\text{C}$ and 54-62% R.H.). Two annual generations were determined on both hosts. The preoviposition period ranged from 12 to 60 days. The oviposition period was 6.26 and 9.21 days. The egg incubation period was 12.5 and 13 days and the hatching period was 3.1 and 3.3 days with 86.6 and 90% hatchability. The duration of total nymphal instars was 56 and 103 days and the duration of generation was 82 and 182 days depending on temperature & RH.

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The adult female longevity was 45 and 120 days for the first and second generations, respectively depending to temperature and R.H%. **Valuli and Kosal (1992)** determined the life history of *I. seychellarum* on ornamental plants in the lab., and found that the life span ranged 70-90 days. **Osman (2005)** mentioned that two overlapping generations occurred for this pest on mulberry seedlings under lab. conditions (25-37°C and 44.5-54.5 R.H). The preoviposition, oviposition and postoviposition periods ranged 20-49, 48-199 and 7-29 days, respectively. Eggs incubation period ranged from 6-24 days. The 1st, 2nd and 3rd nymphal instars lasted for 13-48, 9-65 and 23-88 days, respectively. **Abdel -Rahman et al (2006)** found that *I. seychellarum* can complete its life cycle on mango plants. However, they observed that mango cultivars are not equally susceptible to *I. seychellarum* infestation. The leaf components of secondary metabolites were screened using solvent/solvent extraction technique. The results suggested that peymene, camphene, and limonene play an important role in resistance of Alphonso mango to *I. seychellarum* infestation.

Therefore, this study has been carried out to obtain more information about its biology which may be of practical values about the time and place of effective control measures against such pest.

MATERIALS AND METHODS

The experiments were carried out under field and lab. conditions. Highly infested mango leaves were selected in the field and transferred to healthy mango seedlings transplanted in pots in the lab., monthly field samples were observed and followed up daily. The newly hatched crawlers (20 individuals) were observed daily as well as any changes were recorded. For studying the incubation period, newly laid eggs were isolated from ovipositing females. The ovisacs were carefully kept in glass cages 2× 3 cm. covered with muslin tissues and kept under three different constant temperature 15,25 and 35°C, at three different relative humidities 60,70 and 90% were checked.

To study the duration of the different nymphal instars under these chosen conditions, newly hatched crawlers were monthly transferred to mango seedlings and caged using small cages during the period from December 2005 to November 2006, then daily examined for morphological changes. To study the duration of mature females, the nymphs were observed till they attained the adult stage. The hatching time of the first crawler in the progeny of each of such females were recorded. To prevent crawlers from escape the petiole of each leaf was covered with a thin layer of Vaseline shortly before hatching. The preoviposition, oviposition and postoviposition periods of 20 females monthly isolated from infested leaves of mango and the number of eggs laid by each female was counted. Production of eggs were also estimated at different parts of mango trees and generation limits could be considered as the total sum of the nymphal stage, preoviposition, oviposition, postoviposition and incubation periods. Meteorological records were obtained from the meteorological station (about half a kilometer far from the experimental area). Data obtained as required were subject to statistical analysis.

RESULTS AND DISCUSSION

1- Egg :

A) Incubation Period.

a) **Under insectary conditions** (table 1 & fig. 1): The shortest period occurred in summer with an average of 4.2 ± 0.3 days at 33.0 ± 2.5 and 50% R.H. The longest occurred in winter being 12.5 ± 0.5 . at $15.0 \pm 1.0^\circ\text{C}$ and 60% R.H. In this regards, **Ali (1980)** recorded 8.6 days for *I. seychellarum* under conditions of 17-28°C and 54-62% R.H. **Osman (2005)** found that the incubation period of this pest ranged between 6 days in July and 24 days in February at 32.5°C with 57% R.H and 16.4°C with 65% R.H., respectively.

Table (1): Durations (in days) of developmental stages of *I. seychellarum* under insectary conditions.

Seasons	Egg incubation	Nymphal duration	Female longevity	Total life span	temp. °C	Average R.H%
Winter	12.5 ± 0.5	42.8 ± 1.9	52.1 ± 3.2	107.4 ± 5.6	12-21 15.0 ± 1.0	60
Spring	9.8 ± 0.4	38.4 ± 2.1	39.5 ± 2.5	87.7 ± 5.0	17-25 21.0 ± 1.0	55
Summer	4.2 ± 0.3	25.2 ± 1.8	25.8 ± 1.7	55.2 ± 3.8	28-37 33.0 ± 1.0	50
Autumn	7.7 ± 0.3	33.4 ± 1.8	33.7 ± 2.4	74.8 ± 4.5	24-32 27.0 ± 1.0	70

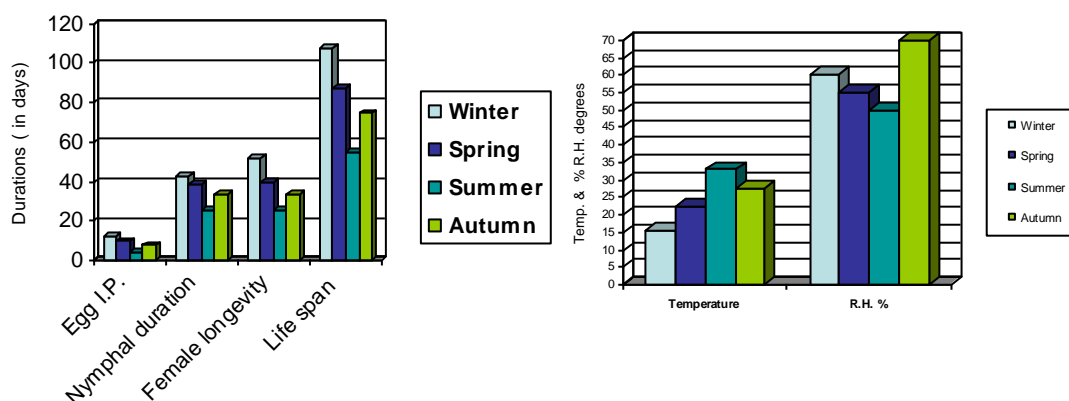


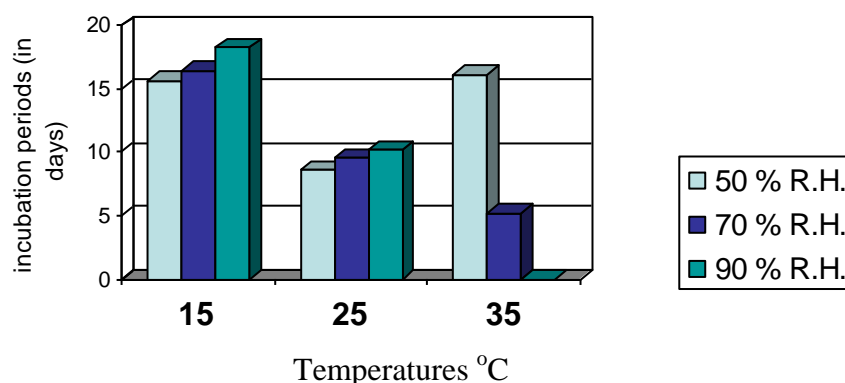
Fig. (1): Durations of developmental stages (in days) of *I. seychellarum* under insectary conditions.

b) Under controlled conditions :

As shown in table (2) and fig. (2) the incubation period was greatly affected by temperature variation. The shortest was 5.2 ± 0.2 days at 35°C and 70% R.H. It increased gradually as the temperature decreased and the longest period was 18.2 ± 1.2 days at $15 \pm 1.0^\circ\text{C}$ and 90% R.H. Changing the R.H from 90 to 50 had minor effect on the egg incubation period at most tested temperatures.

Table (2): Egg incubation period (in days) of *I. seychellarum* under controlled temp. & R.H. given .

Temp. °C	R.H. %		
	50	70	90
15.0±1.0	15.6±0.9	16.4±1.1	18.2±1.2
25.0±1.0	8.6±0.4	9.5±0.6	10.2±0.8
35.0±1.0	6.1±0.3	5.2±0.3	0.0

Fig. (2): Egge incubation periods (in days) of *I. seychellarum* under controlled conditions.**B- Hatching :**

The results (table, 3) showed that the highest % hatch occurred at 25±1.0°C with 50 and 70 R.H being 90 and 95%, respectively, and decreased at the same temperature with 90% R.H. to 70%. No eggs hatched at 35°C with 90% R.H. At 35°C with different tested relative humidies, and at 90% R.H., with different temperatures, the lowest percentage of hatchability occurred. The hatching period averaged 9.7 hrs. (range 8-12) at 25±1.0°C with 70% R.H.

Table (3): Hatching percentages of *I. seychellarum* under controlled conditions.

Temp.	Relative humidity		
	50%	70%	90%
15±1.0 °C	50	65	45
25±1.0 °C	90	95	70
35±1.0 °C	40	55	0.0

2) Nymphal stage :

As presented in table (4) and fig. (3), regardless of temperature variations, the first nymphal instar lasted a shorter period than second or third ones. However, the shortest duration occurred in Summer being 25.2±1.8 days, at prevailing conditions of 33.0±1.0°C and 50% R.H.

For the other seasons, when the temperature decreased, the nymphal periods prolonged and the longest period occurred in Winter (42.8±1.9 days) when the prevailing conditions were 15.0±1.0°C and 60% R.H. In Spring or

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Autumn the duration of the nymphal stages being 38.4 ± 2.1 and 33.4 ± 2.4 days at $21 \pm 1.0^\circ\text{C}$ with 55% R.H ; and 27 ± 1.0 with 70% R.H., respectively.

3) Adult stage:

Parthenogenesis is the only way of reproduction in this species with the absence of males. Eggs laying was in regular rows in an ovisac behind of the female body.

Preoviposition period:

The shortest duration of this period (8.6 ± 0.6 days) occurred in females that reached adulthood in Summer, while the longest (22.3 ± 0.8 days) was for those females attaining the adult stage in Winter (table, 5 and fig. 4).

Table (4): Durations (average in days) of *I. seychellarum* nymphal instars under insectary conditions.

Seasons	No. Observed	nymphal instars			Total	Average	
		1 st	2 nd	3 rd		Temp. °C	R.H.%
Winter	20	14.2	14.6	14.0	42.8 ± 1.9	15.0 ± 1.0	60
Spring	15	12.0	13.8	12.6	38.4 ± 2.1	21.0 ± 1.0	55
Summer	20	7.5	8.2	9.5	25.2 ± 1.8	33.0 ± 1.0	50
Autumn	10	10.8	11.4	11.8	33.4 ± 2.4	27.0 ± 1.0	70

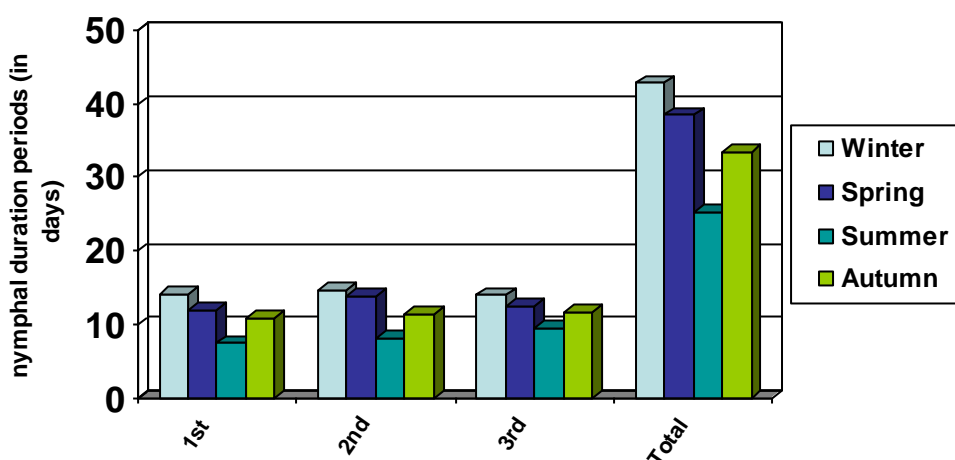


Fig. (3): Durations of *I. seychellarum* nymphal instars (in days) under insectary conditions.

Oviposition period:

As shown in table (5) and Fig. (4) the shortest oviposition period was 7.6 ± 1.2 days in females attaining the adult stage in summer ($33.0 \pm 1.0^\circ\text{C}$ & 50% R.H). The longest period (13.3 ± 1.7 days) occurred in females ovipositing in winter ($15.0 \pm 1.0^\circ\text{C}$ and 60% R.H). The oviposition period previously recorded for this insect in Egypt ranged between 5.2 and 14.2 days

at 17-28 °C with 54-62% R.H (Ali, 1980) while Osman (2005) recorded 48-199 days under laboratory conditions (25-37°C with 44-5-54.7 R.H.).

Postoviposition period:

Postoviposition period averaged 9.6±0.2 and 16.5±1.7 days in Summer and Winter seasons, respectively. It was almost equal in Spring and Autumn seasons being 14.1±1.4 and 13.5 ±1.1 days, respectively.

Longevity: Results given in table (5) & fig. (4) showed that the shortest longevity occurred in hot months, being 25-8± 1.7 days in Summer (33.0±1.0°C and 50% R.H) while in cold months in Winter female longevity increased to 52.1±3.2 days. At moderate temperature and R.H% (Spring and Autumn) average longevity was 39.5±2.5 and 33.7±2.4 at 21.0±1.0°C with 55% R.H. and 27.0±1.0°C with 70% R.H., respectively.

Table (5): Duration (in days) of *I-seychellarum* adult female under insectary conditions.

Seasons	Females longevity periods			Total longevity
	Preovipositions	Ovipositions	Postovipositions	
Winter : 12-21°C 15.0±1.0 & 60% R.H	22.3±0.8	13.3±1.7	16.5±1.7	52.1±3.2
Spring : 17-25°C 21.0±1.0 & 55% R.H	14.6±0.8	10.8±0.5	14.1±1.4	39.5±2.7
Summer : 28-37°C 33.0±1.0 & 50%R.H.	8.6±0.3	7.6±1.2	9.6±0.2	25.8±1.7
Autumn : 24-32 27.0±1.0 & 70% R.H	10.5±0.5	9.7±0.6	13.5±1.1	33.7±2.2

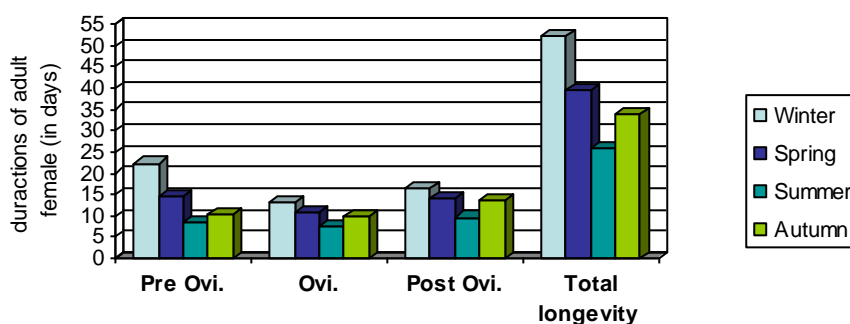


Fig. (4) : Durations (in days) of *I. seychellarum* adult female under insectary conditions.

Duration of the developmental period (life span):

As shown in table (1) and illustrated as in fig. (1) the shortest life span for female (from hatching to death) occurred in those nymphs hatching in Summer being 55.2±3.8 days. In winter (December 2005- February 2006) nymphs development slowed down requiring 107.4±5.6 days. In Spring and Autumn, the female life span was 87.7±5.0 and 74.8±4.5, days at 21.0±1.0°C with 55% R.H. and 27.0±1.0°C with 70% R.H., respectively.

Fecundity: Production of eggs varied with seasons averaging 46.7±2.7 eggs / female, (table, 6). The highest fecundity (75.8 eggs / females) was in October (28.2°C and 70% R.H.). The lowest number of eggs was in December with an

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average 33.0 eggs/female. Meanwhile, the number of eggs laid per female varied with plant parts, the highest number (63.5 ± 2.8 eggs / female) was produced by females fed on mango fruits followed by those fed on branches (52.3 ± 2.5 eggs / female) and the lowest 46.7 ± 2.7 eggs / female by those fed on leaves.

Table (6): Fecundity of *I. seychellarum* fed on different parts of mango trees throughout 2006.

Month	Average no. of eggs / female on		
	Leaves	Branches	Fruits
Jan.	36.0	42.2	0.0
Feb.	35.0	38.1	0.0
Mar.	40.2	60.2	0.0
Apr.	45.0	60.3	0.0
May	50.2	52.7	0.0
Jun.	42.1	50.0	61.2
Juli	35.0	40.2	50.8
Aug.	42.3	55.1	66.7
Sep.	68.1	66.2	75.3
Oct.	75.8	74.0	0.0
Nov.	57.3	45.0	0.0
Dec.	33.0	43.5	0.0
Mean	46.7 ± 2.7	52.3 ± 2.5	63.5 ± 2.8

Generations :

To determine the number of generations at lab. condition, the time when the maximum number of nymphs was recorded which represented the breeding season i.e., the most favorable period for reproduction of the insect. The number of generations was deduced from the peaks of abundance of nymphs during the year as pointed out by **Abdel Aleem (inpress)**.

I. seychellarum had four annual generations. The 1st in March, the 2nd in June, the 3rd in August and the 4th in October. This correlates with the findings of **Osman (2005) and Abdel-Razzik (2006)** reporting 4 annual generations per year.

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***Icerya seychellarum* (Westwood) دراسات بيولوجية على حشرة البق الدقيقى**
رتبة متشابهة الاجنحة ، عائلة البق الدقيقى (Homoptera , Margarodidae)

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أجريت الدراسات الحيوية لحشرة البق الدقيقى *Icerya seychellarum* تحت الظروف الحقلية والمعملية حيث وجدت النتائج الاتية :

أولاً : عدد الاجيال : تمر الحشرة باربعة احيال على مدار العام ولم تظهر ذكور للحشرة خلال فترة الدراسة والتكاثر بكرى بوضع بيض غير مخصب وهو الطريقة الوحيدة لانتاج النسل.

ثانياً : متوسط عدد البيض للانثى 2.7 ± 46.7 بيضة عند تغذيتها على الاوراق اما الاناث التى غذيت على الثمار أعطت كمية أكبر من البيض عن تلك التى تغذت على الافرع أو الاوراق (2.8 ± 63.5 بيضة / الانثى).

ثالثاً: طور البيضة : بلغ متوسط فترة حضانة البيض 0.2 ± 0.2 يوم تحت الظروف المعملية عند درجة حرارة 1.0 ± 35 م° ورطوبة نسبية 70% ولكن كانت هذه الفترة 1.2 ± 18.2 يوم عند درجة حرارة 1.0 ± 15 م° ودرجة ورطوبة نسبية 90% لم يفقس البيض عند درجة 35 م° ورطوبة نسبية 90% .

رابعاً: طور الحورية: تمر الحورية بثلاثة أعمار حيث بلغ متوسط هذا الطور 1.8 ± 25.2 يوم فى فصل الصيف وكانت مدة هذه الطور 1.9 ± 42.8 يوم فى فصل الشتاء وذلك تحت ظروف مناخية 1.0 ± 33.0 م° و 50% رطوبة نسبية و 1.0 ± 15 م° مع 60% رطوبة نسبية على التوالى ، وفى فصل الربيع والخريف كانت هذه الفترة 2.1 ± 38.4 و 2.4 ± 33.4 يوم عند درجة حرارة 1.0 ± 21 م° مع رطوبة نسبية 50% و 1.0 ± 27 م° مع رطوبة نسبية 70% . على التوالى.

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خامساً: طور الحشرة البالغة: بلغ أقل متوسط لفترة ما قبل وضع البيض ، فترة وضع البيض وفترة ما بعد وضع البيض 8.6 ± 0.3 ، 7.6 ± 1.2 و 9.6 ± 0.2 يوم على التوالي وذلك خلال الصيف عند درجة حرارة 33 ± 1.0 م° مع 50% رطوبة نسبية بينما طالبت هذه الفترات لتصل متوسطاتها 22.3 ± 0.8 ، 13.3 ± 1.7 و 16.5 ± 1.7 يوم على التوالي خلال الشتاء عند درجات حرارة 15 ± 1.0 م° و 60% رطوبة نسبية وفي الربيع عند درجات حرارة 21 ± 1.0 م° مع 55% رطوبة نسبية بلغت متوسطات هذه الفترات 14.6 ± 0.8 ، 10.8 ± 0.5 و 14.1 ± 1.4 يوم على التوالي بينما في الخريف وعند درجة حرارة 27 ± 1.0 م° بلغ متوسط هذه الفترات 10.5 ± 0.5 ، 9.7 ± 0.6 و 13.5 ± 1.1 يوم على التوالي.

بلغ متوسط حياة الانثى 25.8 ± 1.7 و 52.1 ± 3.2 يوم في الصيف والشتاء على التوالي.

سادساً : دورة الحياة الكاملة : سجل متوسط دورة الحياة 55.2 ± 3.8 و 107.4 ± 5.6 يوم في فصل الصيف والشتاء على التوالي بينما بلغ هذا المتوسط 87.7 ± 5.0 و 74.8 ± 4.5 يوم في الربيع والخريف على التوالي .