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Life table of the hemispherical scale, *Saissetia coffeae* (Walker) (Hemiptera: Coccidea)

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ABSTRACT

The hemispherical scale, *Saissetia coffeae* (Walker) (Hemiptera: Coccidae) is one of the most important pest attacking olive trees in Egypt. The aim of the present work is to study the biological studies of the hemispherical scale, *S. coffeae*. Mean durations of the first instar were 15.5± 0 .85, 12.8 ± 0.63 and 9±0.76 days at 18, 24 and 30°C, respectively. Second instar lasted for 23.3±0.67, 20.6±0.52 and 16.9± 0.88 days, respectively. While third instar durations were 22.6± 0.70, 19.8±0.63 and 13.2± 0.79, respectively. Incubation periods were 21.4 ± 1.17, 14.4 ± 0.70 and 10.1 ± 0.88 days, respectively. The generation time was 82.80±1.48, 67.6±1.26 and 49.2±2.10 days, respectively. As a result the durations of the adult longevity were 6±0.67, 8.7±0.82 and 8.9 ± 0.74 days at 18, 24 and 30°C, respectively.

KeyWords: Life table, *Saissetia coffeae* , Hemiptera

INTRODUCTION

The hemispherical scale, *Saissetia coffeae* (Walker) (Hemiptera: Coccidae) is one of the most important pest in different parts of the world including Egypt (Dekle ,1965; Ibrahim,1985; Valand *et al.,* 1989 ; Abdel-Rahman ,1995 and Abd-Rabou ,2001, 2005). It has been recorded on different economic crops (Ben-Dov, 1993). This scale is distributed in the tropics and in some sub-tropical areas (Hill, 1983). In Egypt, this species infested guava in Alexandria and Behira (Abd-Rabou, 2001). *S. coffeae* infests different parts of the plant and fruits. A major concern with *S. coffeae* is their excretion of abundant honeydew, which contaminates fruit, leaves, and surfaces beneath plants. Honeydew encourages the growth of black sooty mold and attracts ants, which in turn protect scales from natural enemies. When numerous, some scale species weaken plants and cause them to grow slowly. Branches or other plant parts may die if they remain heavily infested with scales. If plant parts die quickly, dead brownish leaves may remain on branches, giving them a scorched appearance. Several years of severe infestations may kill young plants. Soft scales reduce plant vigor, but seldom kill trees or shrubs (Dekle, 1965; Reinert, 1974; Beardsley and Gonsalves, 1975; Ibrahim,1985 ; Valand *et al.*, 1989 and Gill,1997). Ibrahim (1985) studied the developmental time from egg to adult of hemispherical scale on green potato sprouts at different temperatures. Later, Valand *et al.* (1989) reported the developmental duration of the first, second, and third instars at different temperatures. Hemispherical scale insects are relatively difficult to control because the eggs and young nymphs are protected by the body of the mother. Sprays are effective on the early nymphal stages of scales. However, control is difficult on other life stages. Adults are firmly attached to the plant and remain attached, even after their death. The dead scales may give a false impression of the pest infestation status. Eggs are protected by the waxy covering of the mother and are shielded from chemical sprays. Plant sensitivity to

chemical sprays should also be determined since scales are often pests of sensitive ornamental plants (Copland and Ibrahim, 1985). So the present work will be help to understand the different control methods by studying the biological aspects of this species at different temperatures.

MATERIALS AND METHODS

The hemispherical scale, *S. coffeae* was reared on the squash plants. For biological studies of *S. coffeae* eggs and crawlers were obtained from mother scales reared on squash under laboratory conditions 25-27C, 65-75% RH and 18 hours Photoperiod. The eggs incubation period was determined by using one day old egg of a mother scale. Fifty eggs 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 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 were kept in each Petri dish at the following temperatures: 18°C, 24°C and 30°C. Four replicate Petri dish 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 scale, green potato sprouts, two weeks old, were uprooted from the soil and washed with clean water. Newly emerged crawlers were transferred from the mother scale on to the leaves of potato sprouts using a fine paint brush. Each sprout was infested with 100 crawlers. The infested sprout was then kept in a ventilated polystyrene box (175 mm X 115 mm X 52mm). Two boxes each were kept at each of the temperatures used in the study. Twenty individual scales exposed at each of the various constant temperatures were selected at random for studying their development. The development of the individual scales was observed daily using a stereomicroscope (x 15).

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

RESULTS

The biological and life table parameters of the hemispherical scale, *S. coffeae* at three different constant temperatures (i.e. 18, 24 and 30^{o}C) are presented in Table (1). Expected progeny per female per day and survivorship are graphically illustrated in Figs (1-3).

Mean durations of the first instar were 15.5± 0 .85, 12.8 ± 0.63 and 9±0.76 days at 18, 24 and 30^{o}C, respectively. Second instar lasted for 23.3±0.67, 20.6±0.52 and 16.9± 0.88 days, respectively. While third instar durations were 22.6± 0.70, 19.8±0.63 and 13.2± 0.79, respectively. Incubation periods were 21.4 ± 1.17, 14.4 ± 0.70 and 10.1 ± 0.88 days, respectively.

The generation time was 82.80±1.48, 67.6±1.26 and 49.2±2.10 days, respectively. As a result the durations of the adult longevity were 6±0.67, 8.7±0.82 and 8.9 ± 0.74 days, respectively.

Data presented in Table (1) revealed that the mean generation times (T) for the hemispherical scale, *S. coffeae* as 88.699, 73.348 and 56.163 days at 18, 24 and 30^{o}C,

respectively. The net reproductive rates (R_o) were 37.82, 55 and 97.88. While the intrinsic rates of increase (r_m) were 0.040, 0.054 and 0.08, respectively.

Table (1): Biological and life table parameters of *Saissetia coffeae* on squash at three different constant temperatures.

Parameter	Obtained Value		
	18°C	24°C	30°C
First instar (mean ± SD) (days)	15.5 ± 0 .85	12.8 ± 0.63	9± 0.76
Second instar (mean ± SD) (days)	23.3 ± 0.67	20.6 ±0.52	16.9 ± 0.88
Third instar (mean ± SD) (days)	22.6 ± 0.70	19.8 ± 0.63	13.2 ± 0.79
Incubation period (mean ± SD) (days)	21.4 ± 1.17	14.4 ± 0.70	10.1 ± 0.88
Generation time (days)	82.80 ± 1.48	67.6 ± 1.26	49.2 ± 2.10
Life span (days)	88.8 ±1.48	76.3 ± 1.25	58.1 ± 2.28
Survival rate to maturity	0.3	0.26	0.34
Adult Longivity duration (days)	6± 0.67	8.7 ± 0.82	8.9 ± 0.74
Number of eggs	189.1	275	489.4
Net reproductive rate (R_o)	37.82	55	97.88
Mean generation time (T) (days)	88.70	73.35	56.16
Intrinsic rate of increase (r_m)	0.040	0.055	0.082
Finite rate of increase (exp.r_m)	1.0418	1.056	1.085
Generation doubling time (days)*	35.36	25.89	17.33

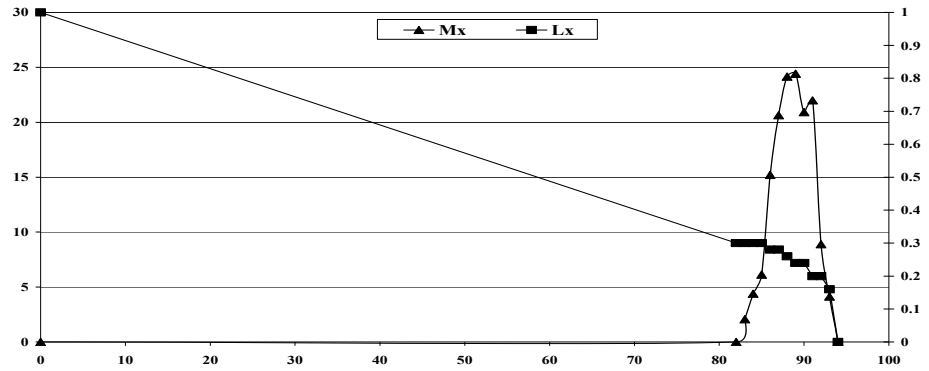

Fig. (1): Expected progeny per female per day and survivorship at 18oC

Mx - Female progeny per female **Lx -** Rate of survival

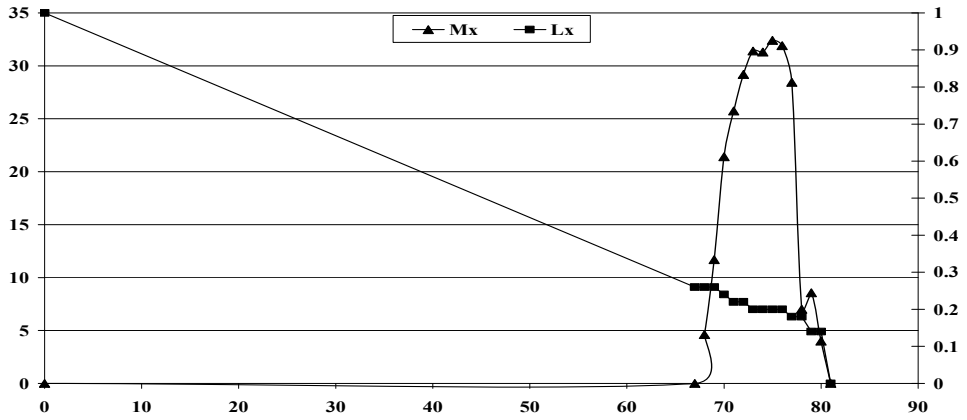

Fig. (2): Expected progeny per female per day and survivorship at 24 oC

Mx - Female progeny per female **Lx -** Rate of survival

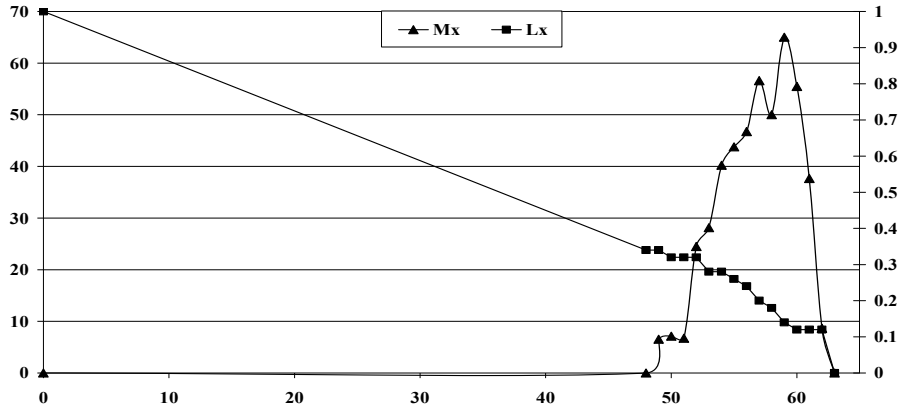

Fig. (3): Expected progeny per female per day and survivorship at 30oC

Mx - Female progeny per female **Lx** - Rate of survival

The finite rates of increase (exp r_m) were 1.04, 1.056 and 1.085; while the generation doubling times were 35.36, 25.89 and 17.33 days at the studied temperatures. Death occurred gradually over the life span (i.e. type II survival). The expected progeny per female reached the maximum value (24.42 progeny/day) after the first week of Viviparity (the day of 89.50) at 18°C. While it reached its maximum (32.4) after 75 days ago after eight days of parturition period at 24°C. The expected progeny per female at 30°C reached the maximum value (65 progeny/day) after the first week of viviparity (the day of 59).

These results indicated that 30°C was the most adequate tested temperature for the hemispherical scale, *S. coffeae* life and because it resulted in the highest oviposition (489.4 eggs/female), the highest r_m value (0.08) the shortest incubation period (10.1 days) the longest adult longevity (8.9).

In this research work the temperature greatly influenced the development of *S. coffeae.* The lowering of the temperature increased the dimension of the scales and lengthened the development period. This statement agrees with the results of Ibrahim (1985), Valand *et al.* (1989) and Li-Chen & Hong (2002). Li-Chen & Hong (2002) stated that nymphal scale continuously reared at 30°C failed to produce adults. The optimum development temperatures of the hemispherical scale were 24-28 °C .These results was contradicting with our data, here the adults produced and optimum development of temperature 30°C. The number of eggs produced by females of *S. coffeae* was inversely correlated with the rearing temperature (Ibrahim and Copland, 1987). This statement agrees with our data but contradicting with Valand *et al.* (1989).

In the present work, the overall development of the scale. at 18, 24 and 30°C were 82.80±1.48, 67.6±1.26 and 49.2±2.10 days, respectively. Studies conducted by Ibrahim (1985) report the developmental time from egg to adult of hemispherical scales on green potato sprouts to be 95.2 days at 18°C and 31.2 days at 28°C. This study showed that the hemispherical scale could thrive at temperatures between 18°C and 28°C, with the optimal development occurring at 26°C (Ibrahim, 1985). The developmental cycle of *S. coffeae* was completed in 131 days at 17.5°C and 64 days at 25°C (Kozhechkin,1984). While Li-Chen & Hong (2002) stated that the developmental duration of the hemispherical scale from egg to adult at 18°C and 28°C were 95.5 and 51.3 days, respectively.

Eggs a study conducted by Ibrahim (1985) reported that the eggs hatched in 23.6, 20.6, 15.6, 15.4, 13.6, and 12.2 days at 18°C , 20°C, 22°C, 24°C, 26°C and 28°C

, respectively. While in this work the eggs hatched in 21.4 ± 1.17, 14.4 ± 0.70 and 10.1 ± 0.88 days, at 18, 24 and 30^{o}C, respectively. In a study conducted by Valand *et al.* (1989) the developmental duration of the first, second, and third instars at 24°C was 12.5, 21.0, and 20.4 days; at 27°C was 10.1, 25.2, and 19.9 days; at 30°C w10.1, 23.7, and 13.1 days respectively. But here mean durations of the first instar were 15.5± 0 .85, 12.8 ± 0.63 and 9±0.76 days at 18, 24 and 30^{o}C, respectively. Second instar lasted for 23.3±0.67, 20.6±0.52 and 16.9± 0.88 days, respectively. While third instar durations were 22.6± 0.70, 19.8±0.63 and 13.2± 0.79, respectively. Incubation periods were 21.4 ± 1.17, 14.4 ± 0.70 and 10.1 ± 0.88 days, respectively. The generation time was 82.80±1.48, 67.6±1.26 and 49.2±2.10 days, respectively. As a result the durations of the adult longevity were 6±0.67, 8.7±0.82 and 8.9 ± 0.74 days, respectively. In Valand *et al.* (1989) the adult longevity was 8.5, 7.8, and 8.4 days at 24, 27 and 30°C respectively . The average number of eggs laid per female during her lifetime was 189, 275 and 489 at 18, 24 and 30°C, respectively . In the study of Valand *et al.* (1989), was 268, 547 and 488 at 24 , 27 and 30°C , respectively.

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ARABIC SUMMARY

جداول الحياة للحشرة النصف كروية القشرية الرخوة

شعبان عبد ربه - نادية على - منيرة محمد الفاتح
معهد بحوث وقاية النباتات - مركز البحوث الزراعية- الدقي- الجيزة- مصر

الحشرة النصف كروية القشرية من أهم الآفات التى تصيب الزيتون فى مصر والعالم . تم فى هذا العمل دراسة تأثير درجات الحرارة المختلفة على دورة حياة الحشرة النصف كروية القشرية الرخوة . و من خلال النتائج أتضح أن فترة حضانة البيض للحشرة الكاملة عند درجات حرارة ١٨و٢٤ و٣٠ درجة مئوية كانت تتراوح من 0.88 ± 10.1 , 0.70 ± 14.4 ,1.17 ± 21.4 على الترتيب. وأن فترات النمو للاعمار اليرقية الأول 0.76±9 ,0.63 ± 12.8 ,.85 0 ±15.5 والثانى 0.88 ±16.9 ,0.52±20.6 ,0.67±23.3 و الثالث 0.74 ± 8.9 ,0.82±8.7 ,0.67±6 و قد أتضح من النتائج أن دورة الحياة لكل الأعمار كانت ,1.48±82.80 2.10±49.2 , 1.26±67.6 عند درجات الحرارة ١٨و ٢٤و ٣٠ درجة مئوية على الترتيب.