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# EFFECT OF PALM CULTIVARS ON CERTAIN BIOLOGICAL AND LIFE TABLE ATTRIBUTES OF THE RED PALM WEEVIL, *Rhynchophorus ferrugineus* (OLIVIER) (COLEOPTERA: CURCULIONIDAE).

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## ABSTRACT

The developmental time of immature stages, developmental rate, longevity, fecundity, and life table parameters of the red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier) were investigated on ten cultivars from four groups of palms (soft date, semi-dry date, dry date and ornamental palms) under laboratory conditions.

The data indicated that there was a significant variation in the developmental time of immature stages of *R. ferrugineus* when reared on the four groups. The highest developmental rate of *R. ferrugineus* was achieved when reared on Samany and Amri cultivars. In addition, there were significant differences between the ten palm cultivars in larval stage, while there were no significant differences in an incubation period and pupal stage on the tested palm cultivars.

There was a significant difference in longevity of male and females between RPW and cultivars. The longest male and female longevity when reared of *R. ferrugineus* on Samany cultivar. Whereas, the shortest longevity when reared on Bartamouda. The fecundity rate (number of eggs/female/day) was high when *R. ferrugineus* female reared on Amri cultivar (5.34 eggs/female/day) while, it was low on Meloky (3.99 eggs/female/day).

From the achieved results, the calculated values of the mean generation time (T) and doubling time (DT) of RPW were shorter on soft date palm cultivars than the other cultivars. The intrinsic rate of increase ($r_m$) and finite rate of increase ($\lambda$) exhibited a similar trend. The values of gross reproductive rate (GRR) and net reproductive rate ($R_o$) were higher on Samany, Barhi, and Amri than the other palm cultivars.

In conclusion, the present study assured that the most susceptible cultivars for RPW population growth were Samany and Barhi. The current investigation provided useful information of some biological and life table aspects of *R. ferrugineus* to use in an integrated pest management of this insect.

**Keywords**: *Rhynchophorus ferrugineus*, soft date, semi-dray date, dry date, ornamental palms, developmental rate, longevity, fecundity, life table parameters.

## INTRODUCTION

The palm, *Phoenix dactylifera* (L.) (Palmae) is the most common and widely cultivated plant in the arid regions of the Middle East and North Africa (Purseglove, 1972; Jones, 1995). The palm crop in the Middle East is now under threat due to infestation by the red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier) (Coleoptera: Curculionidae) (Cox, 1993; Gush, 1997 ;

Aldhafer *et al.*, 1998; Alsuhaibani *et al.*, 2001). This weevil has caused a great deal of damage in recent years (Farazmand *et al.*, 2000; Sacchetti *et al.*, 2006; Bozbuga and Hazir, 2008).

Since its discovery, the weevil has expanded its range very rapidly. By 1995, it had infested over 10,000 farms. In infested plantations, yields have been estimated to have dropped from 10 tones to 0.7 tones per hectare (Gush, 1997). The weevil feeds on a broad range of palms including coconut, sago, date, and oil palms. In some areas, it has also been recorded as a serious pest of introduced palms, particularly coconut (Kalshoven, 1981; Rajamanickam *et al.*, 1995).

Because of the concealed nature of the larvae, effective methods for the management of the red palm weevil have been difficult to develop (Gush, 1997). Determining the life history of an insect is important to understand its development, distribution, and abundance. In polyphagous insects, life history can vary with the plant species or cultivars it feeds on. Different plant species provide different nutritional quality and chemical constituents, which can affect the development, reproduction, and survival of an insect. Chemical or physical factors in plants affect the behavior or growth of insects; alternatively, ecological factors such as phenological differences between insects and plants might affect a restricted host range of insects (Fox and Morrow, 1981; Berenbaum, 1990; Bernays and Chapman, 1994; Schoonhoven *et al.*, 2005).

Life table parameters are essential to know the general biology of an insect and provide a valuable picture for the fecundity and growth potential of this insect under prevailing environmental conditions. Population growth rate is a basic ecological characteristic. Construction of life tables is an appropriate method for description of the insect population dynamics (Southwood, 1978). Developmental times, survival, longevity and fecundity are basic data for life table analysis.

Essential information of developmental time, age-specific fecundity, and survival of the RPW on palm cultivars in Egypt is lacking. Therefore, the current investigation was conducted to study the biological attributes of the RPW on certain palm cultivars, determine the longevity or larval and adult developmental times, estimate the fecundity and egg viability (percentage of egg hatch) and calculate life table parameters of this insect.

## MATERIALS AND METHODS

The cocoons of RPW used in the current study were obtained from infested palms in Dakahlia Governorate in 2005. Cocoons were put in plastic containers (24x16x11 cm.) till adult emergence. Each plastic container was covered with muslin and tightened with rubber band. After emergence, adults were sexed (according to the presence of a series of black hairs on the dorsal, frontal part of snouts of males and their absence in the females) (Rahalaker *et al.*, 1985).

The eggs laid by females were removed daily by peeling the fibrous tissue and picking up eggs using a camel's hair brush to pieces of palm cultivars and monitored until hatching. The viability of the eggs was

determined by counting the number of hatched larvae. Small trunk pieces were punctured to make a shallow cavity in each piece of palm cultivars by using stainless still tack. Each cavity was provided with newly laid eggs. Each container was provided trunk rasped shred of palm cultivars. Surplus fresh palm cultivars were put in the containers for feeding and to serve as oviposition sites. The trunks were replaced weekly and old trunks were confined to separate containers for seven days before examination for weevil eggs and/or larvae. The stages of weevils were examined daily for mortality. The palm cultivars used in the present study were soft dates (Samany and Barhi), semi-dry dates (Amri and Sewi), dry dates (Bartamouda and Sakkoti), and ornamental palms (Seykas, Canarien, Pritchardia, and Meloky). These cultivars are commonly grown in Egypt. None of the cultivars included in this study have been previously examined for rearing the RPW. Twenty five RPW larvae were reared on each palm cultivar. Each reared larva was considered to be a replicate. The developmental time of immature stages, survival from eggs to adult eclosion, and sex ratio were recorded. The developmental rate (1/developmental time) of immature stages was recorded (Omakar and James, 2004).

After adult eclosion, four males and four females of RPW were fed on the palm cultivars until development was completed. The duration of the pre-oviposition, oviposition, post-oviposition periods, the fecundity of females and the longevity of males was recorded. The effect of the feeding on palm cultivars on life table parameters was calculated using a BASIC computer program (Abou-Setta *et al.*, 1986) for females reared on palm cultivars. This computer program is based on Birch's method (1948) for the calculation of an animal's life table. Effect of palm cultivars on population growth of the RPW was assessed by constructing a life table, using rates of age-specific (Lx), and fecundity (Mx) for each age interval (x). To compare the biotic potential of the RPW fed on palm cultivars, the following population growth parameters were determined: the mean generation time (T), the net reproductive increase ($R_o$), the intrinsic rate of increase ($r_m$), and the finite rate of increase ($\lambda$). The doubling time (DT) was calculated according to Mackauer's method (Mackauer, 1983). The life tables were prepared from data recorded daily on developmental time (egg to first egg laid), sex ratio, the number of deposited eggs, the fraction of eggs reaching maturity, and the survival of females. Interval of one day was chosen as the age classes for constructing the life table.

All of the experiments were run in a rearing room of the Economic Entomology Department Laboratory at 26.0±2.0°C, 70.0±5.0% RH, and a photoperiod of 12:12 h. (L:D).

**Data analysis**

Data for developmental time of immature stages, longevity and fecundity of females, and longevity of males reared on palm cultivars were subjected for one way analysis of variance (ANOVA), and the means were separated using Duncan's Multiple Range Test (Costat Software, 1990).

## RESULTS

**I. Developmental times and survival of immature stages:**

Developmental time of immature stages of *R. ferrugineus* when feeding on ten palm cultivars under laboratory conditions is presented in Table (1). Based on the statistical analysis, there were no significant differences between the different palm cultivars in an incubation and pupal periods (P=0.4465 and 0.4394). In contrast, there were significant differences among palm cultivars in larval, pre-pupal stages, and and total days to reach the adult stage (P=0.000, 0.0254, and 0.000). In particular, the total days of immature stages development were short on soft dates (Samany and Barhi), medium on both of semi-dry (Amri and Sewi) and dry dates (Bartamouda and Sakkoti) and long on ornamental palms (Pritchardia and Meloky) (Table1). Developmental rate of *R. ferrugineus* was better on soft date cultivars (Samany and Barhi) (0.0196 and 0.0192) than the other cultivars (Fig. 1).

**Table (1): Developmental time (mean ± SE) in days of immature stages of *R. ferrugineus* when reared on different palm cultivars under laboratory conditions.**

| Palm cultivars | Incubation period | Larval stage | Pre-pupal stage | Pupal stage | Total duration of immature stages |
|---|---|---|---|---|---|
| Samany | 2.00±0.00 a | 37.30±0.44 g | 4.00±0.19 b | 7.70±0.14 a | 51.00±0.44 f |
| Barhi | 2.00±0.00 a | 38.70±0.28 g | 4.10±0.22 b | 7.40±0.15 a | 52.20±0.22 f |
| Amri | 2.00±0.00 a | 42.10±0.33 f | 4.00±0.20 b | 7.70±0.14 a | 55.80±0.29 e |
| Sewi | 2.00±0.00 a | 44.10±0.22 e | 3.80±0.19 b | 7.20±0.13 a | 57.10±0.23 e |
| Bartamouda | 2.00±0.00 a | 44.20±0.23 e | 3.90±0.17 b | 7.30±0.14 a | 57.40±0.18 e |
| Sakkoti | 2.00±0.00 a | 48.80±0.28 d | 4.10±0.22 b | 7.40±0.15 a | 62.30±0.28 d |
| Canarien | 2.00±0.00 a | 48.90±0.84 d | 3.72±0.18 b | 7.63±0.14 a | 62.25±0.33 c |
| Seykas | 2.00±0.00 a | 56.60±0.41 c | 3.72±0.23 b | 7.45±0.15 a | 69.77±0.31 c |
| Pritchardia | 2.00±0.00 a | 65.50±0.90 b | 5.90±0.24 a | 8.45±0.15 a | 81.85±0.22 b |
| Meloky | 2.00±0.00 a | 69.81±0.77 a | 6.45±0.29 a | 9.09±0.30 a | 87.35±0.44 a |

**Means followed by the same letter in a column are not significantly different at the 5% level of probability (Duncan's Multiple Range Test).**

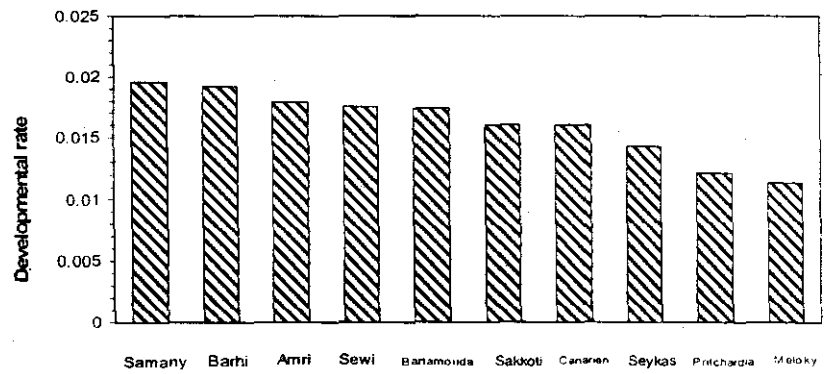


**Figure (1): Developmental rate to *R. ferrugineus* when reared on ten palm cultivars under laboratory conditions.**

Hatching percentage of RPW varied among the palm cultivars from 92.0 to 96.0% (Table 2). The survival percentage of RPW was different significantly between the ten palm cultivars among larval and pupal stages, and from egg to adult eclosion (Table 2). The survival percentage differed from 36.0% on dry date cultivars (Bartamouda and Sakkoti) to 60.0% on Barhi cultivar (soft date palm)

**Table (2): Survival percentage of immature stages of *R. ferrugineus* when reared on ten palm cultivars under laboratory conditions.**

| Palm cultivars | Hatchability % | Larval stage | Pupal stage | Survival % from egg to adult eclosion |
|---|---|---|---|---|
| Samany | 96.0 | 75.0 | 83.0 | 52.0 |
| Barhi | 92.0 | 83.0 | 89.0 | 60.0 |
| Amri | 96.0 | 66.0 | 87.0 | 48.0 |
| Sewi | 96.0 | 62.0 | 87.0 | 40.0 |
| Bartamouda | 96.0 | 50.0 | 83.0 | 36.0 |
| Sakkoti | 92.0 | 61.0 | 83.0 | 36.0 |
| Canarien | 96.0 | 79.0 | 88.0 | 60.0 |
| Seykas | 92.0 | 74.0 | 88.0 | 52.0 |
| Pitchardia | 96.0 | 63.0 | 86.0 | 44.0 |
| Meloky | 96.0 | 58.0 | 86.0 | 44.0 |

**Means followed by the same letter in a column are not significantly different at the 5% level of probability (Duncan's Multiple Range Test).**

**II. Longevity and fecundity of adult stage:**

Longevity of RPW adults fed on different palm cultivars is given in Table (3).

**Table (3): Longevity (mean±SE) in days of *R. ferrugineus* when reared on ten palm cultivars under laboratory conditions.**

| Palm cultivars | Longevity ( mean ±SE)[a] | | | | |
|---|---|---|---|---|---|
| | ♂ | ♀ | | | |
| | | Pre-oviposition | oviposition | Post-oviposition | Total |
| Samany | 103.20± 3.12 b | 4.60± 0.41 bc | 87.00± 1.87 a | 9.80± 0.91 abc | 101.40± 4.59 a |
| Barhi | 108.20± 3.02 a | 3.80± 0.33 c | 84.60± 1.48 b | 11.40± 1.31a | 99.80± 3.46 a |
| Amri | 83.16± 1.60 g | 5.25± 0.54 bc | 66.25± 2.16 e | 9.00± 0.71 bc | 80.50± 2.19 f |
| Sewi | 96.83± 0.70 c | 5.50± 0.83 bc | 74.75± 1.95 d | 11.00± 1.87 a | 91.25± 0.74 c |
| Bartamouda | 91.66± 1.02 d | 5.75± 0.41 b | 74.75± 1.78 d | 8.50± 0.83 c | 89.00± 1.54 d |
| Sakkoti | 86.00± 0.8 f | 8.40± 0.54 a | 66.20± 1.21 e | 8.60± 0.67 bc | 83.20± 1.39 e |
| Canarien | 96.16± 2.16 c | 6.40± 0.35 b | 79.80± 1.86 c | 9.80± 0.90 abc | 96.00± 2.20 b |
| Seykas | 89.28± 0.85 e | 8.50± 0.43 a | 65.00± 0.43 e | 11.00± 0.70 a | 84.50± 1.60 e |
| Pritchardia | 73.50± 19.79 i | 7.80± 0.43 a | 58.60± 1.56 f | 10.00± 0.67 abc | 76.40± 1.4 g |
| Meloky | 76.14± 0.62 h | 8.25± 0.40 a | 55.50± 0.56 g | 10.50± 0.83 ab | 74.25± 0.90 h |

**Means followed by the same letter in a column are not significantly different at the 5% level of probability (Duncan's Multiple Range Test).**

Female longevity was significantly longer (101.40 and 99.80 days) on soft dates (Samany and Barhi) than the other palm cultivars. There were significant differences in male longevity between palm cultivars. The longest longevity period on Barhi cultivar, while the shortest was occurred on Pritchardia cultivar. Concerning the fecundity of females, the average number of eggs per female of RPW was high on soft dates (Samany and Barhi), medium on both of semi-dry (Amri and Sewi) and dry dates (Bartamouda and Sakkoti) and low on ornamental palms (Meloky and Pritchardia) (Table 4).

From data illustrated in Table (4), it could be noted that the fecundity rate (No. eggs/female/day) was high when *R. ferrugineus* female reared on Amri cultivar (5.34 eggs/female/day) while, it was low on Canarien (3.07 eggs/female/day).

**Table (4): Number of eggs per *R. ferrugineus* female and fecundity rate when reared on ten palm cultivars under laboratory conditions.**

| Palm Cultivars | No. eggs/♀ | Fecundity rate (No. eggs/♀/day) |
|---|---|---|
| Samany | 393.40±15.15 a | 4.52 ab |
| Barhi | 394.00±10.26 a | 4.66 ab |
| Amri | 354.00±6.42 b | 5.34 a |
| Sewi | 330.25±10.2 c | 4.41 ab |
| Bartamouda | 329.00±12.49 c | 4.40 ab |
| Sakkoti | 319.80±9.75 d | 4.83 ab |
| Canarien | 245.20±3.71 e | 3.07 b |
| Seykas | 232.00±13.14 f | 3.57 ab |
| Pritchardia | 213.80±9.13 h | 3.65 ab |
| Meloky | 221.75±13.1 g | 3.99 ab |

**Means followed by the same letter in a column are not significantly different at the 5% level of probability (Duncan's Multiple Range Test).**

**III. Life table parameters:**

Data presented in Table (5) illustrated the life table parameters of *R. ferrugineus* female when reared on different palm cultivars. The mean generation time was long on Meloky cultivar (107.16 days). In contrast, it was short on Barhi (65.44 days). The population could be doubled (DT) every 98.44, 95.46, 105.18, 125.80, 128.3, 135.69, 124.4, 148.29, 174.31 and 186.51 days when reared this weevil on Samany, Barhi, Amri, Sewi, Bartamouda, Sakkoti, Canarien, Seykas, Pritchardia and Meloky, respectively. The value of gross reproductive rate (GRR) was higher on Amri 382.3 than the other cultivars. In addition, net reproductive rate ($R_o$), intrinsic rate of increase ($r_m$) and finite rate of increase ($\lambda$) was high on Barhi cultivar.

From the data illustrated in Fig. (2), it could be noted that the survivorship (LX) for female age was higher on Barhi than Samany. The maximum reproduction rate per female per day (Mx) was 14.31 on the third day on Samany. While, it was 14.97 on the fourth day on Barhi. The data in Fig. (3) showed the age-specific fecundity (MX) and survivorship (LX) of *R. ferrugineus* females when reared on semi-dry dates. The survivorship (LX) for female age was higher on Amri than Sewi. The maximum reproduction rate per female per day (Mx) was 17.40 on the fourth day on Amri. While, it was 10.75 on the fourth day on Sewi.

**Table (5): The life table parameters of R. ferrugineus females when reared on ten palm cultivars under laboratory conditions.**

| Palm Cultivars | Life table parameters | | | | | |
|---|---|---|---|---|---|---|
| | Mean generation time (T) (in days) | Doubling time (DT) (in days) | Gross reproductive rate (GRR) | Net reproductive rate ($R_o$) | Intrinsic rate of increase ($r_m$) | Finite rate of increase ($\lambda$) |
| Samany | 67.14 | 98.44 | 220.18 | 112.99 | 0.007 | 1.070 |
| Barhi | 65.44 | 95.46 | 193.00 | 115.83 | 0.007 | 1.070 |
| Amri | 71.03 | 105.18 | 382.30 | 107.88 | 0.006 | 1.068 |
| Sewi | 75.77 | 125.80 | 163.12 | 65.050 | 0.005 | 1.056 |
| Bartamouda | 77.38 | 128.30 | 162.89 | 65.400 | 0.005 | 1.055 |
| Sakkoti | 81.89 | 135.69 | 180.87 | 65.580 | 0.005 | 1.052 |
| Canarien | 80.98 | 124.40 | 152.56 | 91.107 | 0.005 | 1.057 |
| Seykas | 89.09 | 148.29 | 123.93 | 64.370 | 0.004 | 1.047 |
| Pritchardia | 99.69 | 174.31 | 119.86 | 52.680 | 0.003 | 1.040 |
| Meloky | 107.16 | 186.51 | 122.05 | 53.660 | 0.003 | 1.037 |

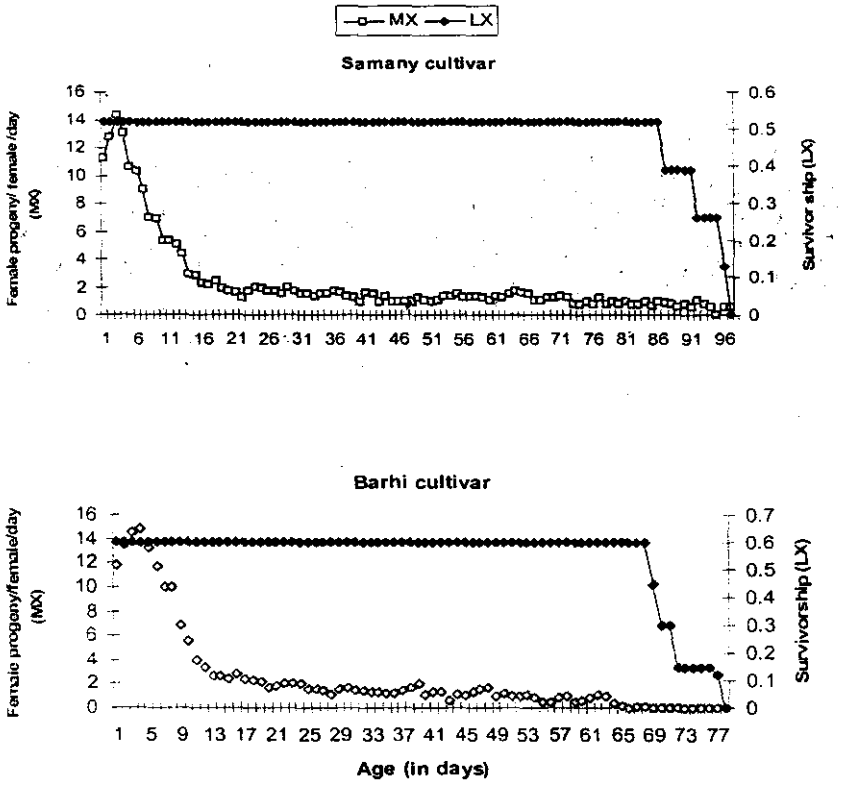


Figure (2): Age-specific fecundity (MX) and survivorship (LX) of *R. ferrugineus* female when reared on soft date under laboratory conditions.

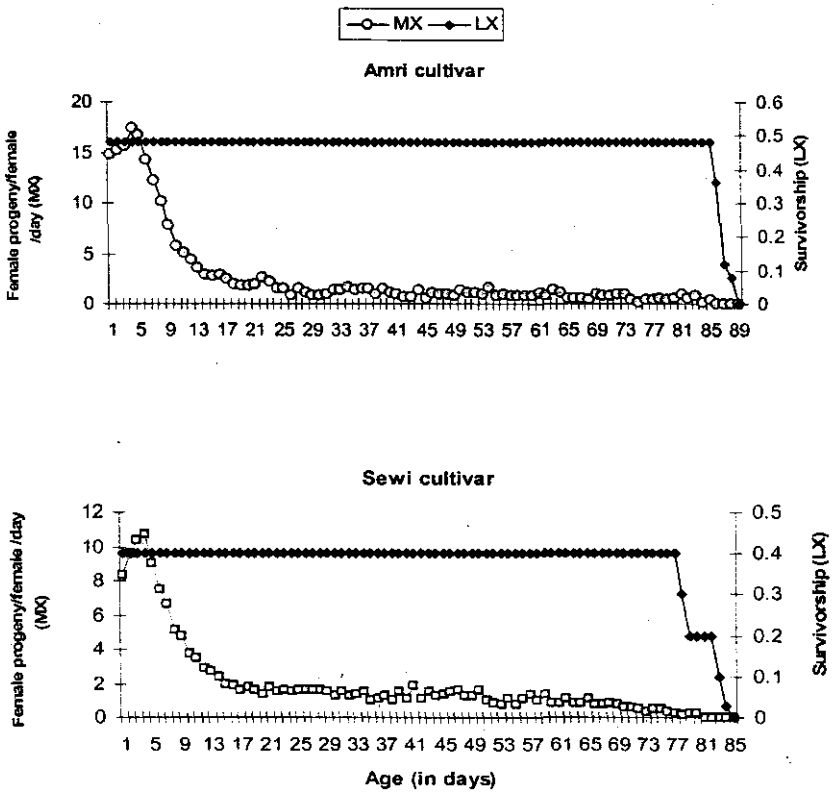


**Figure (3): Age-specific fecundity (MX) and survivorship (LX) of *R. ferrugineus* female when reared on semi-dry dates under laboratory conditions.**

As appears from Fig. (4), the survivorship (LX) for female age was high (0.40) on Bartamouda. Meanwhile, it was low (0.36) on Sakkoti, indicating the decline in the probability of female survival on this cultivar. Maximum daily oviposition per female (MX) was 15.95 on 5$^{th}$ day when female of *R. ferrugineus* fed on Sakkoti while with Bartamouda, the Maximum (MX) value was recorded on 3$^{rd}$ day (7.13).

From the data illustrated in Fig. (4), it could be noted that the survivorship (LX) for female age was high (0.60) on Canarien which means most of eggs developed to maturity and death happened gradually after an extended ovipositional period, while on Seykas, Pritchardia and Meloky the value of (LX) was low 0.52, 0.44 and 0.44, consecutively. Maximum oviposition rate per female per day (MX) was high 12.19 when females fed on Canarien on 4$^{th}$ day, while it was 12.02 on 4$^{th}$ day, 12.69 on 5$^{th}$ day and 11.28 on 4$^{th}$ day when females fed on Seykas, Pritchardia and Meloky, consecutively.

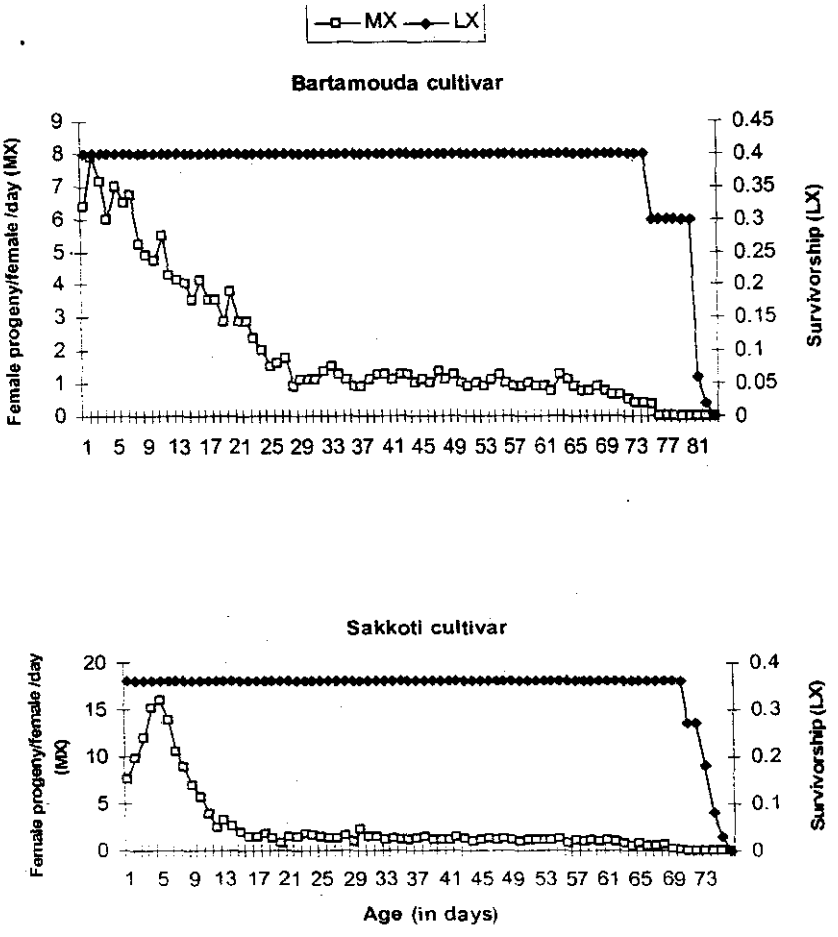


**Figure (4): Age-specific fecundity (MX) and survivorship (LX) of *R. ferrugineus* female when reared on dry dates under laboratory conditions.**

From the data illustrated in Fig. (5), it could be noted that the survivorship (LX) for female age was high (0.60) on Canarien which means most of eggs developed to maturity and death happened gradually after an extended ovipositional period, while on Seykas, Pritchardia and Meloky the value of (LX) was low 0.52, 0.44 and 0.44, consecutively. Maximum oviposition rate per female per day (MX) was high 12.19 when females fed on Canarien on 4$^{th}$ day, while it was 12.02 on 4$^{th}$ day, 12.69 on 5$^{th}$ day and 11.28 on 4$^{th}$ day when females fed on Seykas, Pritchardia and Meloky, consecutively.

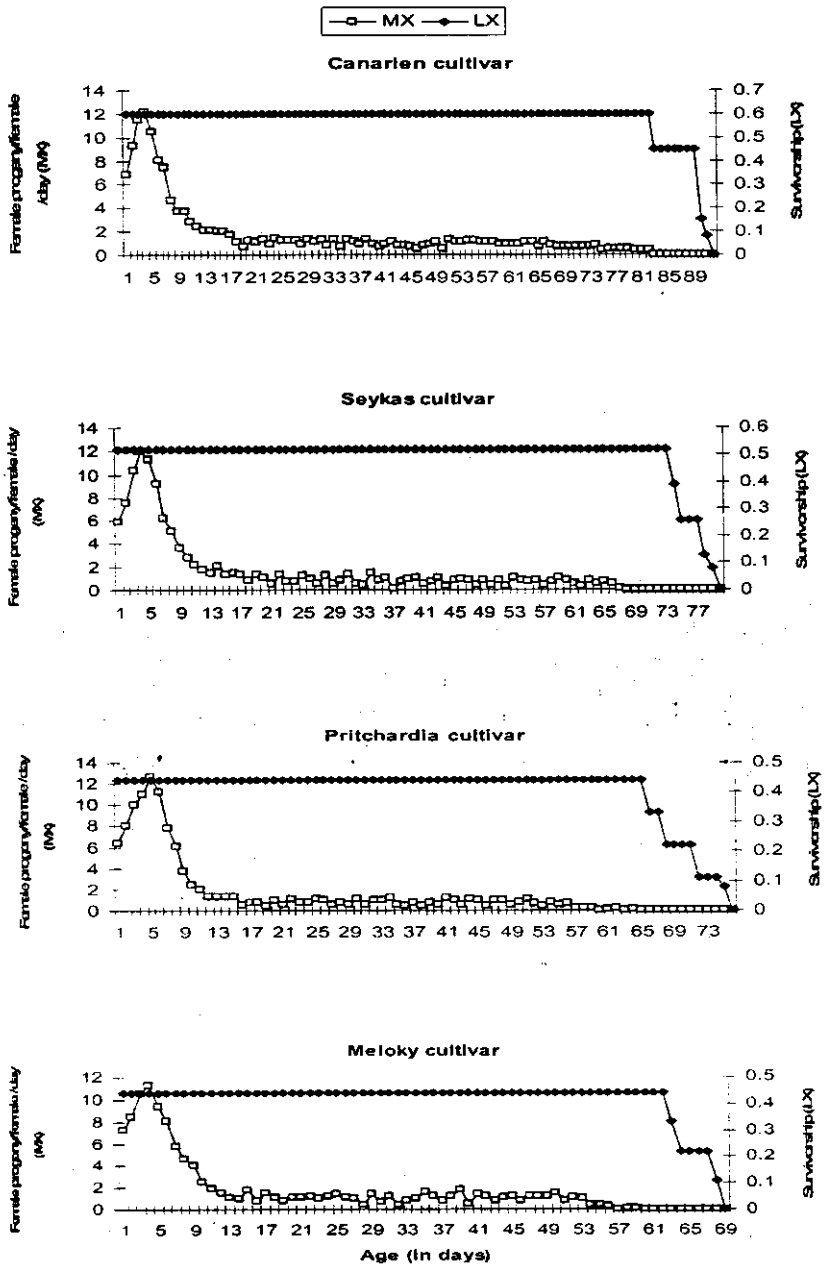


**Figure (5): Age-specific fecundity (MX) and survivorship (LX) of *R. ferrugineus* female when reared on ornamental palms under laboratory conditions**

## DISCUSSION

The red palm weevil (RPW) invaded Egypt in 1992, where it is now causing severe damage to date and ornamental palms (Gush, 1997; Farazmand *et al.*, 2000; Sacchetti *et al.*, 2006; Bozbuga and Hazir, 2008). None of the cultivars included in this study have been previously examined for rearing the RPW.

Biological information of this insect is essential for assessing the potential rate of increase of a population and for the prediction of the number of generations that could occur in one crop season. In addition, any pest management program requires an understanding of the biology and ecology of this pest.

The results of this study indicated that there was no significant variation in the developmental time of incubation period and pupal stage between the ten tested palm cultivars, while significant differences occurred with larval, pre-pupal, and total duration of immature stages. Larval development was clearly shorter on preferred palm cultivar. If this pattern holds under field conditions over the course of the year, it would be possible for weevil developing on Samany and Barhi cultivars to complete an additional generation relative to weevil developing on other cultivars.

Our results are in complete agreement with those addressed by Farazmand (2002) who studied the food preference of RPW on five date palm cultivars (Mazafati, Rabbi, Halileh, Zardan and Pimazoo) and a native wild palm. Based on the laboratory studies, the maximum and minimum larval mortality were recorded on Zardan and Halileh, respectively. The highest pupal mortality was 100%, which was found in the wild palm. The maximum and minimum adult emergence was observed for Mazafati and wild palm, respectively. The life span of RPW was maximum on Zardan and minimum on Mazafati. The highest and the lowest daily oviposition were observed on Mazafati and Zardan, respectively. In addition, Krishnakumar and Maheswari (2004 b) determined the effect of different cultivars of coconut on the development of *R. ferrugineus* and found that there was no significant change in the incubation period of eggs laid by the weevils reared on different cultivars of coconut. The larval period was shortest on Green dwarf followed by Lakshadweep ordinary. The larval period was significantly higher in West coast tall when compared to Green dwarf. The adult longevity was significantly highest in weevils reared on Green dwarf followed by those reared on Lakshadweep ordinary and was significantly least in weevils reared on Orange dwarf. The percentage survival of larvae (last instar), pupae and adult was significantly highest on Green dwarf.

The interaction of various nutrient components affected the vital qualifications of RPW. The most effective were sugar and calcium. Sugar was correlated with growth, daily oviposition and reduction in mortality, while increase in calcium clearly inhibited RPW growth (Farazmand *et al.*, 2000; Farazmand, 2002; Krishnakumar and Maheswari, 2004 a).

There are no published data on the biological and life table parameters of RPW on the tested palm cultivars for comparison. Whereas,

there were some investigations on biological characters on different diets for this insect (Table 6). The variations between the developmental periods of immature stages and longevity of adults in this study with the previous study (Table 6) may have been due to suboptimal conditions (food type, temperature, and rearing methodology). Differences in fecundity of females appeared more closely related to insect physiology than to any other factors (Kaakeh, 2005).

Our results for the net reproductive rate varied from 52.680 (Pritchardia) to 115.83 (Barhi). According to Krishnakumar and Maheswari (2004 a) who determined the multiplication rate of red palm weevil on coconut. They reported that from the 10 pairs of adult beetles used, 75 adults were generated in the next generation. Thus, from one pair of adult weevils, 8 adults could be expected. Hence, the multiplication rate of the red palm weevil in the field will be 8. Since, the sex ratio of the red palm weevil was 1:1, it could be concluded that from one pair of red palm weevil, 4 males and 4 females could be produced. Our results indicated that the sex ratio of RPW on different palm cultivars was 1:1.

It could be concluded from the present study that the most suitable cultivars for RPW population growth was Samany and Barhi. These results may explain why the populations of this insect significantly higher on these cultivars than the other cultivars in Egypt. In addition, the rate of increase of weevil even at the lowest density is useful in portraying the principles of weevil population management by any control measure. Life table parameters on the tested cultivars are also needed to construct models of predicting weevil outbreaks and to enhance the effect of various methods of suppression.

**Table (6): Summary of developmental time (in days) of immature stages, longevity and fecundity of *R. ferrugineus* (Quoted from the literature).**

| Stages / References | Egg | Larva | pupa | Immature stage | Longevity ♂ | Longevity ♀ | Fecundity |
|---|---|---|---|---|---|---|---|
| Ghosh (1912) | - | 30-35 | - | - | 50-90 | - | 127-276 |
| Leefmans (1920) | - | - | - | - | - | - | 531 |
| Viado and Bigornia (1949) | - | 35-38 | - | 45-68 | 83.6 | 60.0 | 162-350 |
| Nirula (1956) | - | 36-78 | - | - | 60-90 | - | 355-760 |
| Lever (1969) | - | - | - | - | 90-120 | - | 200-500 |
| Frohlich and Rodewald (1970) | - | - | - | - | - | - | 204 |
| Hartley(1977) | - | 60.0 | - | - | 120.0 | - | 200-500 |
| El-Ezaby (1997) | 4.5 | 69.5 | 23.0 | - | 66.6 | 67.6 | 70-229 |
| Aldhafer *et al.*(1998) | - | 165.0-182.0 | 23.3 | - | 161.0 | 113.0 | 55-412 |
| Muralidharan *et al.* (2000) | | | | 67.3 | 70 | 58 | 206 |
| Salama and Abdel-Razek (2002) | | | | | 172.00 | 170.00 | |
| El-Sebay *et al.* (2003) | | 78.0 - 98.0 | | | | | |
| Krishnakumar and Maheswari (2004 b) | | 50.8 - 63.2 | | | | | |
| Kaakeh (2005) | - | 86.1 | 21.0 | - | 96.3 | 96.0 | 77.2-185.2 |
| Kalleshwaraswamy and Jagadish (2005) | | | | | | | 55.40 |
| Muthiah and Nair (2006) | | | | 75.00 | | 27- 56 | |

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## تأثيرأصناف النخيل على بعض الصفات البيولوجية وجداول الحياة لحشرة سوسة النخيل الحمراء

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تم دراسة تأثير عشرة أصناف من النخيل تابعة لأربعة مجموعات هى مجموعـة الـبلح الرطبـة (أصناف سماني وبرحى) ومجموعة نخيل البلح نصف جافة (عامري وسيوى ) ومجموعـة نخيـل الـبلح الجافة (برتمودا وسكوتي).ومجموعة نخيل الزينة (كناري ، سيكاس ، بريتشارديا وملوكى) علـى فتـرات النمو والبقاء وفترات الحياة ومقاييس جداول الحيـــاة لحشرة سوسة النخيـل الحمـراء تحـت الظـروف المعملية.

أظهرت النتائج وجود فروق معنوية في طول فترة نمو الأطوارغير الكاملة لسوسة النخيل الحمـراء عندما ربيت على أصناف النخيل التابعة للمجموعات الأربعة. وكان أعلى معدل النمو على صـنفى سـماني وعمرى وهى من الأصناف الرطبة. أظهرت النتائج وجود فروق معنوية فى فترة الطور البرقى بينمـا لـم توجد أى فروق معنوية فى فترة حضانة البيض وطور العذراء للأصناف المختبرة.

أوضحت الدراسة وجود فروق معنوية فى فترات الحياة لكل من الذكور والإناث وكذلك الخـصوبة للإناث وذلك بين أصناف المجموعات الأربعة. أشارت النتائج أن أطول فترة لحياة الذكرو والإنـاث كانـت عندما ربيت الحشرة على صنف البلح الرطب (سمانى) وكانت أقل فترة حياة على كل من صنفى برتومـودا وكناريا . أما أعلى معدل لوضع البيض كان على أصناف البلح الرطبة (سمانى وبرحى) وكان أقـل معـدل لوضع البيض على أصناف نخيل الزينة (سيكاس ، بريتشارديا وملوكى).

وأظهرت النتائج أيضا أن قيم جدول الحياة المحسوبة لفترة الجيل (T) ، الزمن الـلازم للتـضاعف (DT) كانت أقصر عندما ربيت السوسة على صنفى سمانى وبرحى وكانت أعلى فى قيمة معـدل الزيـادة الطبيعى ($r_m$) ،معدل الزيادة النهائى ($\lambda$) وقيم معدل الحياة (Lx) ، قيم معامل التـضاعف ($R_o$) ، معـدل التكاثر (GRR) ومعدل وضع البيض/ أنثى / يوم (Mx) لسوسة النخيل الحمـراء علـى صـنفى النخيـل الرطب. ونستخلص من نتائج هذه الدراسة أن صنفى البلح الرطب (سمانى وبرحى) كانت أكثر الأصـناف حساسية للإصابة بهذه الآفة الحشرية ونتائج هذه الدراسة يمكن إستخدامها فى وضع برامج المكافحـة لتلـك الآفة الحشرية الهامة على أصناف النخيل المختلفة.