

## Biological Studies and Estimation Life Table Parameters of *Duranta* Aphid, *Aphis durantae* Theobald on *Duranta* Plants under Fluctuated Temperature Conditions

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### ABSTRACT

This study was carried out to study the biology and life table parameters of *Duranta* aphid, *Aphis durantae* Theobald under laboratory conditions throughout three different temperatures degrees (winter, spring and summer) during 2018 year. Data obtained showed that the spring season more suitable for *A. durantae* living (biology) more than winter and summer seasons, respectively. This showed clearly from life table's parameters which showed that the nymphal stages of *A. durantae* in spring season were less than in winter and summer, respectively. Also, life cycle, mean generation time, live span and longevity duration in spring season were less than in winter and summer seasons respectively. Lastly, the important parameter in the life table, intrinsic rate of increase ( $r_m$ ) in spring season was more than in winter and summer seasons, respectively.

### INTRODUCTION

*Duranta* plants consider one of the importance, beautiful and famous hedges and ornamental plants all over the world. It is called "Golden dewdrop". They are commonly cultivated as hedges and ornamental plants. Also, *duranta* plants is one of the most permanent green leafy plants, characterized by bright green leaves, which reproduce through the peripheral part. *Duranta* is a genus of plants in the verberna family (Verbenaceae). It contains 17 species of shrubs and small trees that are widespread all over the world. Iram, S. *et al.* (2015) in Pakistan found that *duranta* is a common ornamental plant of the family Verbenaceae that is often grown as garden hedge in Pakistan.

On the other hand, *duranta* plants also cultivated for medicinal purposes in many countries all over the world. Sharma, P. *et al.* (2012) studied the antifungal activity of *duranta* plants against some phytopathogenic fungi as a result of antifungal activity it was found that the extract of leaf which contain also many pharmaceutical drugs.

*Duranta* aphid, *Aphis durantae* Theobald (Homoptera: Aphididae) is the most serious pest of *duranta* plants. The adults and nymphs of aphid attack the *duranta* plants, tender shoots and buds. The aphids are apterous and reproduce parthenogenetically. Aphid populations may increase very rapidly under natural conditions. Ahmed. S. and El-Deeb, M. (2007) found that *duranta* aphid, *A. durantae* infested *duranta* plants all over the year, leaves were the highly infested plant part that received aphids attack. El-Nagar, S. *et al.* (1982) found that the *Duranta* aphid, *Aphis durantae* Theobald is considered a major pest of *duranta* plants in Egypt.

This study was carried out to study the biology and life table parameters of *Duranta* aphid, *A. durantae* under laboratory conditions throughout three different temperatures degrees (winter, spring and summer) during 2018 year.

### MATERIALS AND METHODS

The present study was carried out to study the biology and life table parameters of *Duranta* aphid, *Aphis durantae* Theobald under laboratory conditions throughout three different temperatures degrees (winter, spring and summer) during 2018 year, and this study was divided into three experiments:

At the first experiment which was carried out during winter season, the mean daily temperature was  $11.25 \pm 0.65^\circ\text{C}$ . which ranged from 10.32 to  $12.42^\circ\text{C}$ . The mean

relative humidity was  $55.32 \pm 1.35\%$  R.H. which ranged from 50.34 to 60.67 % R.H.

At the second experiment which was carried out during spring season, the mean daily temperature was  $23.15 \pm 0.73^\circ\text{C}$ , which ranged from 22.17 to  $24.42^\circ\text{C}$ . The mean relative humidity was  $65.32 \pm 1.85\%$  R.H. which ranged from 60.35 to 70.63% R.H.

At the third experiment which was carried out through summer season, the mean daily temperature was  $32.25 \pm 0.73^\circ\text{C}$ , which ranged from 31.64 to  $33.42^\circ\text{C}$ . The mean relative humidity was  $75.42 \pm 1.65\%$  R.H. which ranged from 70.34 to 80.25% R.H.

In each experiment apterous (mothers) were collected from *duranta* plants in the field, then thirty newly-borne progenies (first instar nymphs) resulted from these mothers were transferred separately using a fine hair brush on discs of filter paper wetted with few water droplets inside thirty clean plastic Petri-dishes. The cover of these plastic Petri-dishes were replaced with muslin cover for good conditions of air and humidity. Fresh leaves of certain *duranta* plants were offered daily to each aphid for feeding.

**Each group of nymphs was monitored daily until death and the following observations were made:**

- Cast skin was removed regularly and periods elapsed between successive moults were recorded.
- Duration of the generation was recorded as time elapsed between birth and first parturition.
- The fraction of progeny reached maturity.
- Sex ratio was considered as one, since all progeny developed to females.
- Survival of individuals throughout their developmental duration.

In the biological study trials, the obtained data of life table study was analyzed following Birch, L. (1948) using Life 48 Basic Computer Program (Abou-Setta *et al.*, 1986).

### RESULTS AND DISCUSSION

The present study was carried out to study the biology and life table parameters of *Duranta* aphid, *Aphis durantae* Theobald under laboratory conditions throughout three different temperatures degrees (winter, spring and summer). This study was carried out during 2018 year and this study was divided into three experiments:

**First experiment:( Winter season)**

At the first experiment which was carried out during winter season, the mean daily temperature was  $11.25 \pm 0.65^\circ\text{C}$ , which ranged from 10.32 to  $12.42^\circ\text{C}$ . The mean

relative humidity was  $55.32 \pm 1.35\%$  R.H. which ranged from 50.34 to 60.67% R.H.

Data tabulated in Table (1) show life table parameters and statically analysis of *A. durantae* during winter season (2018 year).

**Table 1. Life table parameters of *A. durantae* during winter season at  $11.25 \pm 0.65^\circ\text{C}$  and  $55.32 \pm 1.35\%$  R.H.**

Parameter	Obtained value
First instar (mean±sd) days	1.85±0.67
Second instar (mean±sd) days	1.56±0.53
Third instar (mean±sd) days	1.60±0.43
Fourth instar (mean±sd) days	1.75±0.52
Life cycle	8.76±0.65
Mean generation time (T) (days)	14.53
Life span (days)	16.75±0.85
Longevity duration	10.64±0.53
Survival rate to maturity	69%
Viviparity duration (days)	6.73±0.63
Net reproductive rate ( $R_0$ )	36
Intrinsic rate of increase (rm)	0.47
Finite rate of increase (exp. rm)	1.68
Generation doubling time (days)*	2.85

(\*) =  $\ln 2/rm$

Data are present as mean±sd

Data obtained from Table (1) show that the mean durations of the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instars were 1.85, 1.56, 1.60 and 1.75 days, respectively, the Life cycle period was 8.76 days, while the mean generation time (T) was 14.53 days. The life span period was 16.75 days, the longevity duration was 10.64 days. The survival rate to maturity reached to 69%. The viviparity duration was 6.73 days. The net reproductive rate ( $R_0$ ) and the intrinsic rate of increase (rm) were 36.0 and 0.47, respectively. The finite rate of increase (exp. rm) reached to 1.68, while the generation doubling time was 2.85 days.

**Second experiment: (Spring season)**

At the second experiment which was carried out during spring season, the mean daily temperature was  $23.15 \pm 0.73^\circ\text{C}$ , which ranged from 22.17 to  $24.42^\circ\text{C}$ . The mean relative humidity was  $65.32 \pm 1.85\%$  R.H. which ranged from 60.35 to 70.63% R.H. Data tabulated in Table (2) show life table parameters and statically analysis of *A. durantae* during spring season (2018 year).

**Table 2. Life table parameters of *A. durantae* during spring season at  $23.15 \pm 0.73^\circ\text{C}$  and  $65.32 \pm 1.85\%$  R.H.**

Parameter	Obtained value
First instar (mean±sd) days	1.35±0.45
Second instar (mean±sd) days	1.26±0.47
Third instar (mean±sd) days	1.30±0.42
Fourth instar (mean±sd) days	1.45±0.53
Life cycle	6.85±0.75
Mean generation time (T) (days)	12.32
Life span (days)	14.26±0.84
Longevity duration	9.35±0.40
Survival rate to maturity	74%
Viviparity duration (days)	7.85±0.65
Net reproductive rate ( $R_0$ )	38
Intrinsic rate of increase (rm)	0.65
Finite rate of increase (exp. rm)	1.35
Generation doubling time (days)*	2.37

(\*) =  $\ln 2/rm$

Data are present as mean±sd

Data obtained from Table (2) show that the mean durations of the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instars were 1.35, 1.26,

1.30 and 1.45 days, respectively, the Life cycle period was 6.85 days, while the mean generation time (T) was 12.32 days. The life span period was 14.26 days, the longevity duration was 9.35 days. The survival rate to maturity reached to 74%. The viviparity duration was 7.85 days. The net reproductive rate ( $R_0$ ) and the intrinsic rate of increase (rm) were 38.0 and 0.65, respectively. The finite rate of increase (exp. rm) reached to 1.35, while the generation doubling time was 2.37 days.

**Third experiment: (Summer season)**

At the third experiment which was carried out through summer season, the mean daily temperature was  $32.25 \pm 0.73^\circ\text{C}$ , which ranged from 31.64 to  $33.42^\circ\text{C}$ . The mean relative humidity was  $75.42 \pm 1.65\%$  R.H. which ranged from 70.34 to 80.25% R.H.

Data tabulated in Table (3) show life table parameters and statically analysis of *A. durantae* during summer season (2018 year).

Data obtained from Table (3) show that the mean durations of the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instars were 2.68, 2.45, 2.75 and 2.85 days, respectively, the Life cycle period was 10.43 days, while the mean generation time (T) was 16.25 days. The life span period was 18.40 days, the longevity duration was 11.45 days. The survival rate to maturity reached to 65%. The viviparity duration was 5.85 days. The net reproductive rate ( $R_0$ ) and the intrinsic rate of increase (rm) were 34.0 and 0.26, respectively. The finite rate of increase (exp. rm) reached to 1.83, while the generation doubling time was 3.75 days.

**Table 3. Life table parameters of *A. durantae* during summer season at  $32.25 \pm 0.73^\circ\text{C}$  and  $75.42 \pm 1.65\%$  R.H.**

Parameter	Obtained value
First instar (mean±sd) days	2.68±0.45
Second instar (mean±sd) days	2.45±0.47
Third instar (mean±sd) days	2.75±0.55
Fourth instar (mean±sd) days	2.85±0.42
Life cycle	10.43±0.65
Mean generation time (T) (days)	16.25
Life span (days)	18.40±0.35
Longevity duration	11.45±0.53
Survival rate to maturity	65%
Viviparity duration (days)	5.85±0.75
Net reproductive rate ( $R_0$ )	34
Intrinsic rate of increase (rm)	0.26
Finite rate of increase (exp. rm)	1.83
Generation doubling time (days)*	3.75

(\*) =  $\ln 2/rm$

Data are present as mean±sd

**-Comparison between some life table parameters of *A. durantae* at different temperatures degrees (winter, spring and summer):**

Data tabulated in Table (4) show comparison between nymphal stages, life cycle, mean generation time, life span, longevity duration and intrinsic rate of increase (rm) in the different temperatures degrees (winter, spring and summer). Obtained data show that the most seasons which more suitable for *A. duranta* living or biology was (spring, winter and summer), respectively.

This shows clearly from Table (4) whereas the nymphal stages period in spring were less than in winter and summer respectively. Also, life cycle, mean generation time, life span and longevity periods in spring were less than in winter and summer respectively. Lastly, the essential parameter in biology comparison, intrinsic rate of increase

(rm) in spring season was more than its value in winter and summer respectively. *rosae*.

**Table 4. Comparison between nymphal stages, life cycle, mean generation time, life span, longevity duration and intrinsic rate of increase (rm) in the different seasons: winter, spring and summer during 2018 year**

Parameter	Obtained value		
	Winter	Spring	Summer
First instar (days)	1.85	1.35	2.68
Second instar (days)	1.56	1.26	2.45
Third instar (days)	1.60	1.30	2.75
Fourth instar (days)	1.75	1.45	2.85
Life cycle (days)	8.76	6.85	10.43
Mean generation time (T) (days)	14.53	12.32	16.25
Life span (days)	16.75	14.26	18.40
Longevity duration (days)	10.64	9.35	11.45
Intrinsic rate of increase (rm)	0.47	0.65	0.26

The obtained results are in agreement with those obtained by Emam, A. S. (2009) who found that the nymphal stages (first instar, second instar, third instar and fourth instar) for *Macrosiphum rosae* on rose plants were 1.68, 1.36, 1.31 and 1.55 days, respectively. And life cycle, life span, generation time and longevity duration were 6.90, 15.36, 6.77 and 9.45 days, respectively. Mohamad, M. and Al-Mallah, N. (1987) who studied the biology of the rose pest *M. rosae* under laboratory conditions in Mosul, Iraq. He found that generations varied significantly in terms of fecundity, duration of the nymphal stage and adult life span.

There were 4 nymphal instars, of which the 1st was the longest and the 2nd the shortest. The intrinsic rate of natural increase (rm) ranged from 0.25 to 0.63. The rm values were similar under laboratory and field conditions. Kakar, K. and Sood, A. (1989) found that the 4 nymphal stages were completed in an average of 12.95 days in March and 12.70 days in November, and survival, adult lifespan and fecundity were higher in March than in November. On the other hand, Bisht, R. S. *et al.*, (2001) found that the subtropical and temperate climate, enforcing the sexual reproduction in rose aphid, is favourable for the appearance of sexuales of *M. rosaeiformis*. Finally, Olmez, S. *et al.*, (2003) found that the developmental periods of immature stages ranged from 10.7 days at 17.5°C to 7.95 days at 25°C. The total percentages of survivorship of immature stages varied from 52.06 and 86% within the temperature range of 17.5-25°C. The average longevity of adult females was 13.92, 10.74, 18.55, and 8.65 days at 17.5, 20, 22.5 and 25°C, respectively. Mohsen, M. and Hatami, B. (2017) studied effect of temperature on some biological parameters of an Iranian population of the Rose Aphid, *Macrosiphum rosae* (Hemiptera: Aphididae), and found that the degree 25°C is the most suitable degree for reproduction of *M.*

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## دراسات بيولوجية وتقدير قياسات جدول الحياة لحشرة من الدورانتا *Aphis durantae* على نباتات الدورانتا تحت ظروف درجات الحرارة المتغيرة

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أجريت هذه الدراسة بغرض دراسة دورة الحياة (بيولوجية) لحشرة من الدورانتا *Aphis durantae* Theobald والتي تعتبر أهم الآفات التي تصيب نباتات الدورانتا. كما استهدفت الدراسة أيضا تقدير وحساب جدول الحياة Life table للحشرة وذلك على ثلاث درجات حرارة مختلفة. لذلك تم إجراء الدراسة في ثلاثة مواسم (فصول): الشتاء، الربيع، الصيف خلال عام 2018 تحت الظروف المعملية. أوضحت النتائج أن فصل الربيع حيث درجات الحرارة المعتدلة كانت أكثر ملائمة لتكاثر وتوالد حشرة من الدورانتا وذلك بالمقارنة بالموسمين الآخرين، يليه موسم الشتاء ثم أخيرا موسم الصيف. ويتضح ذلك جليا من قياسات جدول الحياة حيث يتضح منها تناقص فترة الأعمار الحورية الأربعة Nymphal stages في فصل الربيع عنها في فصلي الشتاء والصيف على الترتيب. كما يتضح ذلك أيضا من تناقص فترة دورة الحياة Life cycle، و متوسط فترة الجيل Mean generation time، وفترة حود الحياة Life span، وفترة البقاء Longevity duration في موسم الربيع عنها في موسمي الشتاء والصيف على الترتيب. وأخيرا يتضح ذلك جليا من أهم مقاييس جدول الحياة وهو معدل الزيادة الأساسى للحشرة (rm) Intrinsic rate of increase حيث يتضح زيادة هذا المعدل في فصل الربيع وذلك بالمقارنة بالفصلين الآخرين الشتاء والصيف على الترتيب.