J. Agric. Sci. Mansoura Univ., 29 (12): 7465 - 7480, 2004

EFFECT OF TEMPERATURE ON CERTAIN BIOLOGICAL AND LIFE TABLE PARAMETERS OF *Rhopalosiphum maidis*, *Aphis craccivora*, AND *Aphis nerii* (Hemiptera: Aphididae).

Abdel-Salam, A. H.
Economic Entomology Department, Faculty of Agriculture, Mansoura University, Mansoura 35516, EGYPT
E-mail : adhabdel@mans.edu.eg

ABSTRACT

The developmental times, survivorship, longevity, fecundity, and life table parameters of three aphid species namely, *Rhopalosiphum maidis* (Fitch), *Aphis craccivora* Koch. and *Aphis nerii* Boyer de Fonscolobe were investigated at two constant temperatures 25 and 30°C.

The data revealed that there was no significant variation in the developmental time of *R. maidis* nymphs between the two tested temperatures, while, these differences statistically occurred with *A. craccivora* and *A. nerii*. The survival percentage of the three aphid species differed significantly between the two tested temperatures. The higher survival percentage was observed at 30°C.

The female longevity was decreased at 30°C more than at 25°C with the three aphid species. The regression analysis indicated that the female fecundity rate of *R. maidis* and *A. craccivora* at the two tested temperatures decreased gradually with the older age of the female. This relationship was not found with *A. nerii* at both 25 and 30°C.

From the obtained results, the calculated values of the mean generation time (T) and doubling time (DT) of *R. maidis*, *A. craccivora*, and *A. nerii* were shorter at 30°C than at 25°C. The intrinsic rate of increase (r_m) and finite rate of increase (λ) exhibited a similar trend. Meanwhile, the values of gross reproductive rate (GRR) and net reproductive rate (R_o) were higher at 25°C than at 30°C for the three aphid species.

keywords: *Rhopalosiphum maidis*, *Aphis craccivora*, *Aphis nerii*, biological characteristics, temperature, life table parameters.

INTRODUCTION

Aphids are important pests causing direct feeding damage to agricultural crops and indirect damage as vectors of plant virus diseases. The aphid species, *R. maidis*, *A. craccivora*, and *A. nerii* are major insect pests on their host plants in Egypt (Ghanim, 1984; Ismail *et al.*, 1991; Abou El-Hagag et al., 2001; Al-Eryan and El-Tabbakh, 2004).

The corn leaf aphid, *R. maidis* has a wide host range among the Germinae, including more than 30 genera and most cereal crops, especially barley, sorghum, wheat, and maize. The major damage is in the first half of the crop season, when it causes direct yield loss and a vector of several plant viruses affecting Germinae crops (Darwish and Ali, 1991; Blackman and Eastop, 2000; Asin and Pons, 2001). The corn leaf aphid builds up in the curls of the leaves and corn stalk where they suck juices from the plant tissue

on the upper part of the plant. They may completely cover large areas. The aphids secrete a sticky substance known as honeydew, which makes the plant sticky with its accumulation and in heavy infestations, it hinders pollination. Silk and tassels may turn sooty black as mold which grows on the honeydew. Clusters of aphids may cause yellow patches on the leaves by injection of toxins into plants. High populations can cause discoloration of outside husk layers. *Rhopalosiphum maidis* is an important vector of maize dwarf mosaic virus, sugarcane mosaic virus, and barley yellow dwarf virus (Noda, 1960; Foster *et al.* , 2004).

Aphis craccivora is the principal aphid species of legumes and other crops in Egypt and other parts of the world. Heavy infestation of young seedlings can cause death and stunt the growth, distort leaves and induce delay in flowering of older plants (Rani and Remamony, 1998; Nasser *et al.*, 2000). Infestation after flowering causes pod shriveling and a reduction of the yield. It also shows mild to extensive damage to several vegetable crops (Gutierrez *et al.* ,1971).

The oleander aphid, *A. nerii* is a common pest of several important ornamental shrubs and other crops (e.g. fruit trees, sugarcane, sorghum, soybean) (Ismail *et al.*, 1991; Sanchez *et al.*, 1993). It is commonly found feeding on oleander. This species is cosmopolitan, being found in tropical to warm temperate regions throughout the world. The oleander aphid is able to transmit several viruses including sugarcane mosaic potyvirus and papaya rings potyvirus (Hall and Ehler, 1980). The damage caused by aphid colonies is mainly aesthetic due to the large amounts of sticky honeydew produced by the colony members and the resulting black sooty mold that grows on the honeydew. In addition, the growing terminals can be deformed (Blackman and Eastop, 2000)

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. Life table definitions include: 1) age-specific fecundity rate (*Mx*) which is the mean number of female offspring produced per surviving female during the age interval (x), 2) survivorship rate (*Lx*) which is the fraction of females living from birth to age (x), 3) the mean generation time (*T*), which is the average age of females producing nymphs in a population that is in a stable age distribution, 4) the doubling time (*DT*) which is the time (in days) needed for the population to double, 5) the net reproductive increase (R_o), which is the average number of female offspring from a birth cohort of females during their lifetime if they experience a fixed pattern of age-specific birth and death rate, 6) gross reproductive rate (GRR)=ΣMx, which is the mean total number of offspring produced by a female over its life time, 7) intrinsic rate of increase (r_m), which is a measure of per capita instantaneous rate of change in population density expressed as female progeny per female per day, and 8) the finite rate of increase (λ), which is the proportional change in population density from one day to the next, expressed in the same unit as the (r_m) (Hulting *et al.*, 1990 and Tang *et al.*, 1999).

Essential information of developmental time, temperatures, age-specific fecundity, and survival of the aphid species are lacking.

Understanding of the insect pest biology is important for development of accurate management recommendations as well as a reliable pest population prediction system. Temperature is probably the most important physical environmental factor influencing the development, reproduction of insects, and regulates insect population dynamics, and seasonal occurrence. Numerous studies have illustrated the effect of temperature on the biological and population growth of aphids (Kersting *et al.*, 1999; Tang *et al.*, 1999; Xia *et al.*, 1999; Liu and Yue , 2000; McCornack *et al.* , 2004).

In Egypt, little information is available on the effect of temperatures on biological characteristics and life table parameters of the most common aphids, *R. maidis*, *A. craccivora*, and *A. nerii*. Therefore, the current investigation was conducted to study the influence of temperatures on biological attributes of the three aphid species, as well as testing the effect of temperatures on life table parameters of these species.

MATERIAL AND METHODS

Females of *R. maidis, A. craccivora*, and *A. nerii* were obtained from maintained cultures in the laboratory collected previously from maize, cowpea, and oleander shrubs at the Experimental Research Station, Faculty of Agriculture, Mansoura University. Five apterous, parthenogenesis females of each aphid species were confined in glass Petri dishes (9 cm in diameter) on corn tassel, leaves of cowpea and oleander to produce nymphs. Each Petri dish was provided with a layer of moistened filter paper to provide humidity. All nymphs produced within 24 hours were assumed uniform age. There were 15 replicates for each aphid species for each temperature. First instar nymphs were reared individually in the incubators at 25±0.5 or 30±0.5°C. The relative humidity was 60.0±5.0% and the photoperiod was 14:10 (L:D) with each temperature. The tassels or leaves were replaced every two days. Each first instar nymph was placed on new tassels and leaves in a separate Petri dish and observed to determine the developmental time of nymphal instars, survival percentage of each instar and total days taken to reach the adult stage. The presence of exuviae was used to determine molting. The pre-reproductive, reproductive, and post-reproductive periods were determined. In addition, the number of offspring born of each day of adult life and survival were recorded every 24 hours. All nymphs produced were removed after each count.

All experimental data concerning the above characters (developmental times survivorship, longevity, fecundity, and fecundity rate) were analyzed with one-way analysis of variance (ANOVA). Comparisons of means of biological characters were made with the Duncan's Multiple Range Test (Costat Software, 1990).

To compare biological parameters of the three aphid species reared at the two temperatures, survivorship rate (Lx), age-specific fecundity (Mx), the mean generation time (T), the net reproductive increase (R_o), the intrinsic rate of increase (r_m), the gross reproductive rate (GRR) (=ΣMx), and the finite rate of increase (λ) were calculated for each species for each temperature

using a BASIC computer program (Abou-Setta *et al.*, 1986). This computer program is based on Birch's method for the calculation of an animal's life table (Birch, 1948). The doubling time (*DT*) was calculated according to Mackauer's method (Mackauer, 1983). The life tables were prepared from the data recorded daily on developmental time, the number of produced nymphs, the fraction of nymphs reaching maturity, and the survival of females. An interval of one day was chosen as the age classes for constructing the life table.

RESULTS

I. Developmental times and survival of nymphal instars:

Developmental time of the four nymphal instars of *R. maidis* feeding on corn tassels at the two tested temperatures is presented in Table (1). There were no significant differences between the two temperatures in nymphal instars (P=0.148). The development as a percentage to total development of the four instars of nymphs was 28, 26, 22, and 24%, respectively at 25°C, whereas at 30°C, they were 26, 25, 25, and 24%, successively (Table 1).

Table (1): Average developmental time (mean±SE)[a] in days and percentage [b] of nymphal instars of *R. maidis*, *A. craccivora*, and *A. nerii* reared at two constant temperatures.

Nymphal Instar	*R. maidis*		*A. craccivora*		*A. nerii*	
	25°C	30°C	25°C	30°C	25°C	30°C
1st	1.40± 0.12 a (28%)	1.13± 0.08 a (26%)	1.13± 0.09 a (21%)	1.00± 0.00 a (23%)	1.93± 0.15 a (28%)	1.13± 0.09 b (22%)
2nd	1.26± 0.11 a (26%)	1.06± 0.06 a (25%)	1.06± 0.06 a (20%)	1.00± 0.00 a (23%)	1.33± 0.12 a (19%)	1.13± 0.09 a (22%)
3rd	1.06± 0.06 a (22%)	1.06± 0.06 a (25%)	1.27± 0.11 a (24%)	1.06± 0.06 a (25%)	1.47± 0.13 a (21%)	1.13± 0.09 b (22%)
4th	1.20± 0.10 a (24%)	1.02± 0.10 a (24%)	1.87± 0.16 a (35%)	1.20± 0.10 b (29%)	2.13± 0.19 a (32%)	1.80± 0.14 a (34%)
Total days to reach the adult stage	4.93± 0.23 a	4.47± 0.18 a	5.33± 0.22 a	4.27± 0.11 b	6.87± 0.29 a	5.20± 0.22 b

[a] **Means followed by the same small letter in a row between the two temperatures for each aphid species are not significantly different at the 1% level of probability (Duncan's Multiple Range Test).**

[b] **Values between brackets are instar development percentage to the total development of nymphal stage.**

There were significant differences among *A. craccivora* at the two tested temperatures in the fourth nymphal instar and total days to reach the adult stage (P=0.000 and 0.000), but not significant in the first, second, and

third instars of nymphs (P=0.153, 0.325, and 0.151). In particular, the total days of nymphal development were 5.33 and 4.27 days at 25 and 30°C. The percentage of development of the nymphal instars was 21, 20, 24, and 35%, successively at 25°C, and 23, 23, 25, and 29% for the four instars of nymphal stage at 30°C. The survival rate was different significantly between the two tested temperatures among third instar and total survival of nymphal stage (P=0.005 and 0.002), but not significant with the first, second, and fourth instars.

Concerning *A. nerii*, the developmental time of nymphs was significantly shorter at 30°C (5.2 days) than at 25°C (6.87 days) (P=0.000). The percentage of development of four instars was 28, 19, 21, and 32% at 25°C, while at 30°C; it was 22, 22, 22, and 34%. The fourth instar required more time than the proceeding three instars at both tested temperatures (25°C and 30°C) (Table 1). The data in Table (2) indicate that the survival rate of the three species was significantly higher at 30°C (75.56%) than at 25°C (65.0%) (P=0.000).

Table 2. Survival percentage [a] of nymphal instars of *R. maidis*, *A. craccivora*, and *A. nerii* reared at two constant temperatures.

Nymphal Instar	*R. maidis*		*A. craccivora*		*A. nerii*	
	25°C	30°C	25°C	30°C	25°C	30°C
1st	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a
2nd	97.50 a	100.0 a	100.0 a	100.0 a	94.00 a	92.22 a
3rd	96.10 a	94.70 a	98.39 a	94.02 b	92.55 a	93.98 a
4th	90.50 b	94.40 a	96.72 a	95.45 a	74.71 b	87.17 a
Total survival	84.80 b	89.50 a	95.16 a	89.74 b	65.00 b	75.56 a

[a] **Means followed by the same small letter in a row between the two temperatures for each aphid species are not significantly different at the 1% level of probability (Duncan's Multiple Range Test).**

II. Longevity and fecundity of females:

In Table (3), there were no significant variations in the pre-reproductive, reproductive, post-reproductive, and total longevity of adult females of *R. maidis* when reared at 25 and 30°C. The mean total fecundity (mean number of offspring/female) was 45.53 and 41.07 nymphs at 25 and 30°C, respectively. The fecundity rate (mean number of nymphs/female/day) was significantly higher at 25°C (4.52 nymphs) than at 30°C (3.77 nymphs) (P= 0.012). The simple linear regression between female age (independent variable X) and the mean fecundity rate (dependent variable Y) of *R. maidis* females reared at 25°C yielded R^2=0.7221 (P=0.000). The regression equation was: Female fecundity rate (Y) = 6.0366-0.2616 female age (X). This equation indicated that there was a highly negative relationship between female age and fecundity rate (Fig. 1). At 30°C, the value of R^2 was 0.7521 (P=0.000) and the regression equation was: Y= 5.3495-0.2497X.

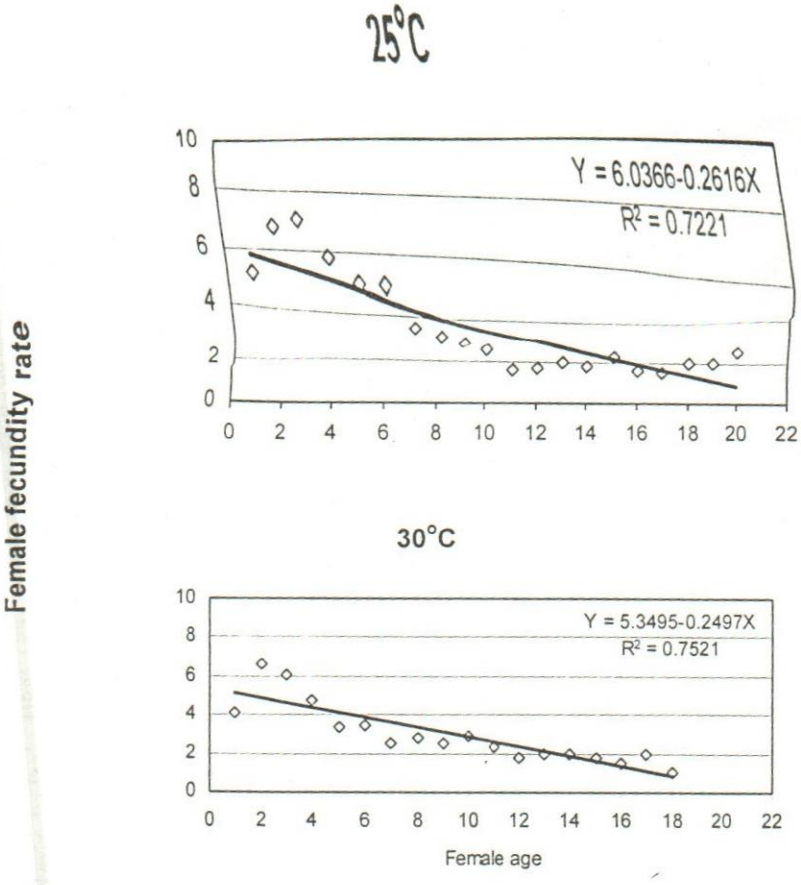

Fig. (1): Relationship between adult female age and fecundity rate of *R. maidis* at 25 and 30°C.

Table (3): Longevity and fecundity (mean±SE)[a] of *R. maidis*, *A. craccivora*, and *A. nerii* reared at two constant temperatures.

Variable	*R. maidis*		*A. craccivora*		*A. nerii*	
	25°C	30°C	25°C	30°C	25°C	30°C
Longevity: Pre-reproductive period	1.06± 0.06 a	1.06± 0.06 a	1.06± 0.06 a	1.00± 0.00 a	1.53± 0.19 a	1.00± 0.00 b
Reproductive period	11.0± 1.46 a	11.33± 0.98 a	14.47± 0.69 a	12.33± 0.41 b	12.13± 0.60 a	11.87± 0.29 a
Post-reproductive period	1.26± 0.11 a	1.53± 0.21 a	1.33± 0.12 a	1.60± 0.16 a	2.53± 0.28 a	1.73± 0.27 a
Total longevity	13.33± 1.47 a	13.80± 0.99 a	16.93± 0.71 a	14.93± 0.44 b	16.13± 0.16 a	14.60± 0.52 a
Total mean of fecundity	45.53± 4.62 a	41.07± 2.25 a	94.00± 2.91 a	60.66± 3.44 b	21.2± 1.99 a	11.20± 1.08 b
Total mean of fecundity rate	4.52± 0.23 a	3.77± 0.13 b	6.49± 0.19 a	4.92± 0.20 b	1.76± 0.14 a	0.96± 0.10 b

[a]Means followed by the same small letter in a row between the two temperatures for each aphid species are not significantly different at the 1% level of probability (Duncan's Multiple Range Test).

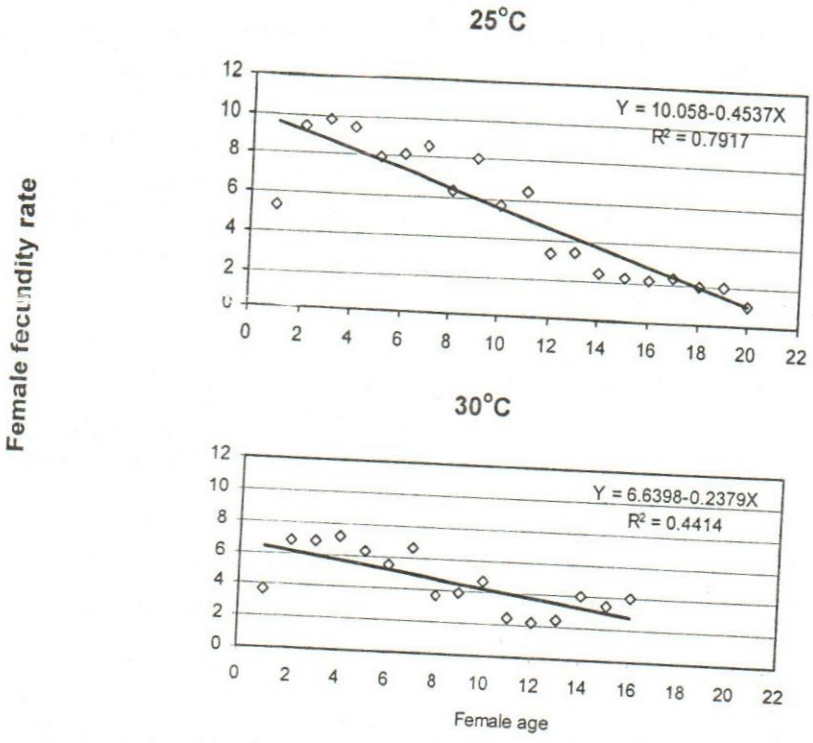

Fig. (2): Relationship between adult female age and fecundity rate of *A.craccivora* at 25 and 30°C.

The ANOVA indicated that there were no statistical variations in pre-reproductive and post-reproductive periods for *A. craccivora* at the two tested temperatures (P=0.325 and 0.205) (Table 3). Meanwhile, there were significant differences between 25 and 30°C in reproductive, longevity periods, fecundity, and fecundity rate (P=0.016, 0.027, 0.000, and 0.000, respectively). The following regression equation was calculated for *A. craccivora* at 25°C between female age and fecundity rate: (Y) =10.058-0.4537 (X) (R^2=0.7917, P=0.000). At 30°C, this equation was (Y) =6.6398-0.2379 (X) (R^2=0.4414, P=0.011).

Based on the statistical analysis, there were significant variations between the two tested temperatures in pre-reproductive period, fecundity, and fecundity rate of *A. nerii* (P= 0.009, 0.000, and 0.000, respectively) (Table 3). Meanwhile, there were no significant differences in the other parameters (reproductive, post-reproductive, and longevity periods) (P= 0.701, 0.059, and 0.074). Simple linear regression between female age and fecundity rate of *A. nerii* females reared at 25°C yielded R^2=0.2888 (P=0.026). The regression equation was: (Y) = 2.135-0.05541 (X). At 30°C, the value of R^2 was 0.0092 (P=0.743) and the regression equation was: Y= 1.099-0.0123 X. From these equations, there was no relationship between female age and fecundity rate of *A. nerii* (Fig. 3).

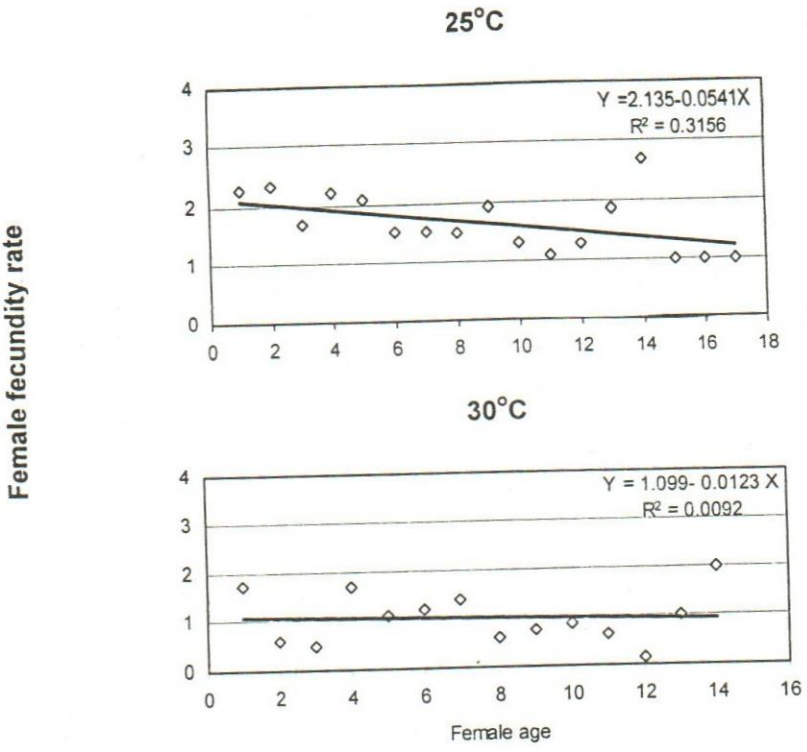

Fig. (3): Relationship between adult female age and fecundity rate of *A. nerii* at 25 and 30°C.

III. Life table parameters:

The durations of mean generation time (T) were 9.04 and 8.60 days for *R. maidis* at the two tested temperatures (Table 4). The population could be doubled (DT) every 1.71 and 1.65 days at 25 and 30°C. The values of gross reproductive rate (GRR), net reproductive rate (R_o), intrinsic rate of increase (r_m), and finite rate of increase (λ) were higher at 25°C than at 30°C. From the data illustrated in Fig. (4), it could be noted that the survivorship (Lx) for female age was higher (0.895) at 30°C than at 25°C (0.8480). The maximum reproduction rate per female per day (Mx) was 7.07 on the third day at 25°C, while at 30°C, Mx was 6.60 on the second day.

Table (4): Life table parameters of *R. maidis*, *A. craccivora*, and *A. nerii* reared at two constant temperatures.

Life table parameter	*R. maidis*		*A. craccivora*		*A. nerii*	
	25°C	30°C	25°C	30°C	25°C	30°C
Mean generation time (T) (in days)	9.04	8.60	10.24	8.96	12.79	8.66
Doubling time (DT) (in days)	1.71	1.65	1.58	1.55	3.38	3.36
Gross reproductive rate (GRR)	38.56	36.75	89.45	54.44	13.78	8.66
Net reproductive rate (R_o)	65.76	53.59	105.89	73.88	28.21	14.10
Intrinsic rate of increase (r_m)	0.4042	0.4189	0.4388	0.4459	0.2049	0.2061
Finite rate of increase (λ)	1.4981	1.5204	1.5509	1.5620	1.2274	1.2289

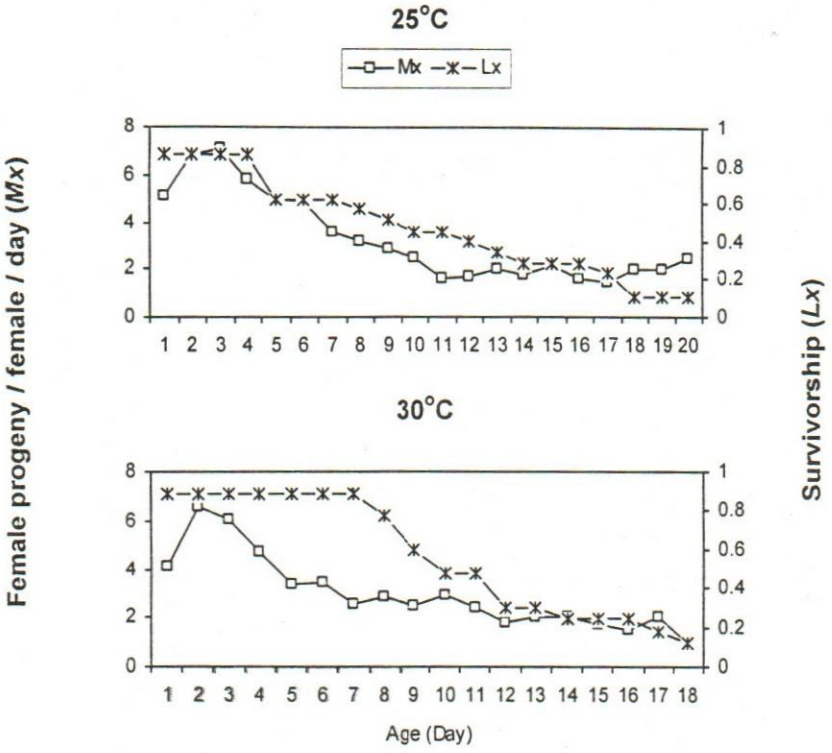

Fig. (4): Age-specific fecundity (*Mx*) and survivorship (*Lx*) of *R. maidis* at 25 and 30°C.

The mean generation time (T) of *A. craccivora* was 10.24 and 8.96 days at 25 and 30°C (Table 4). Meanwhile, the doubling time (DT) was 1.58 and 1.55 days. The higher value of gross reproductive rate (GRR) was obtained when this aphid was reared at 25°C. The net reproductive rate (R_o), intrinsic rate of increase (r_m), and finite rate of increase (λ) were 105.89, 0.4388, and 1.5509 at 25°C, while at 30°C, these values were 73.88, 0.4459 and 1.5620. The survivorship (Lx) for female age was 0.9516 and 0.8974 when the females were reared at both temperatures. The maximum reproduction rate (Mx) was 9.73 on the third day at 25°C, while at 30°C, Mx was 7.20 on the fourth day. Reproduction was continued until the last days of the reproduction period (Fig. 5).

According to life table analysis for *A. nerii*, the mean generation time (T) was shorter (8.66 days) at 25°C than at 30°C (12.79 days). The doubling time (DT) was 3.38 and 3.36 days at the same temperatures. The gross reproductive rate (GRR) was 13.78 and 8.66. The net reproductive rate (R_o) and intrinsic rate of increase (r_m), and finite rate of increase (λ) were 28.21, 0.2049, and 1.2274 at 25°C and 14.10, 0.2061, and 1.2289 at 30°C (Table 4). From the data illustrated in Fig. (6), the survivorship (Lx) was higher at 30°C than at 25°C. The maximum (Mx) was 2.67 and 2.00 on the forteenth day at both temperatures.

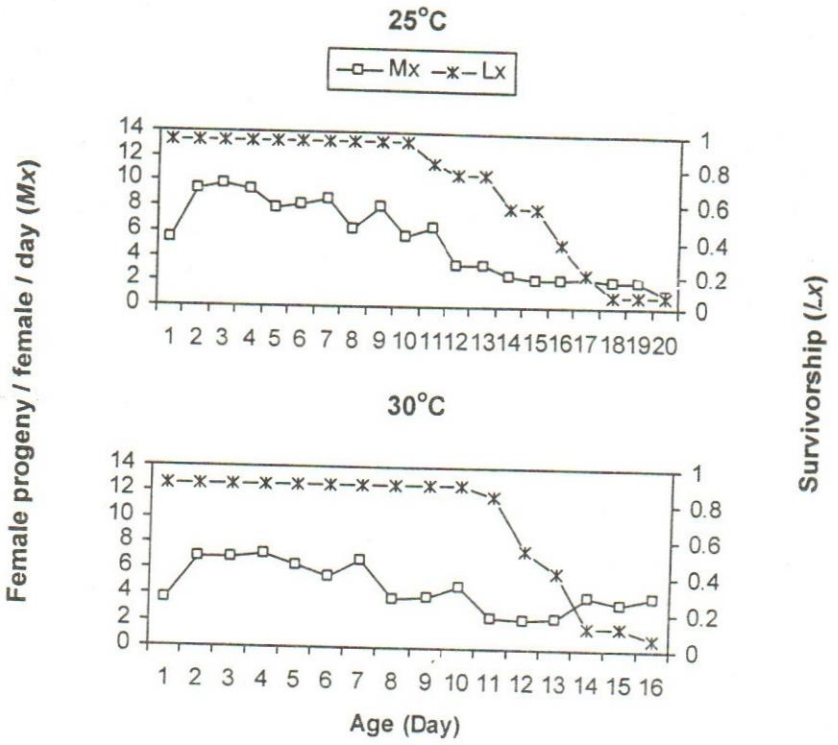

Fig. (5): Age-specific fecundity (*Mx*) and survivorship (*Lx*) of *A. craccivora* at 25 and 30°C.

DISCUSSION

Biological information of aphid species are 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 *R. maidis* nymphs between the two tested temperatures 25°C and 30°C, while significant differences occurred with *A. craccivora* and *A. nerii*. Noda (1960) reported that *R. maidis* finishes one generation in 5.0 days at 25°C. In contrast, when Elliott *et al.* (1988) reared *R. maidis* on barley, they found that the nymphal stage took 5.25 days at 26°C and 5.58 days at 29°C. In addition, Sharma and Bhatnagar (2002) also reared *R. maidis* on barley and reported that the developmental time of nymphal stage averaged 7.07 days.

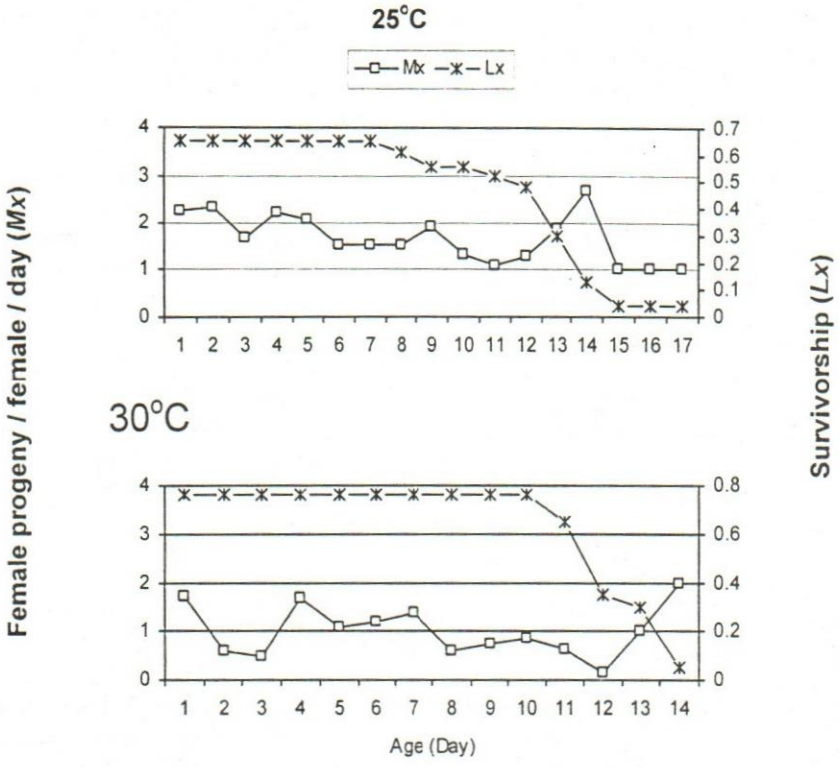

Fig. (6): Age-specific fecundity (*Mx*) and survivorship (*Lx*) of *A. nerii* at 25 and 30°C.

According to Gutierrez *et al.* (1971), *A. craccivora* needed 5.8 days to complete a generation at 20°C, while, Verma *et al.* (1983) mentioned that the duration of *A. craccivora* nymphal stage was 4.4 days at 31°C. The nymphs of this cowpea aphid survived for 4.84 days at 22.7-27.2°C (Srikanth and Lakkundi, 1988), and 5.0-6.75 days on green graminous varieties (Das and Dutta, 1999). Generally, the development of aphid species is faster at 30°C than at 25°C (Xia *et al.*, 1999; McCornack *et al.*, 2004). The survival percentage of the three aphid species differed significantly between the two tested temperatures 25°C and 30°C. The higher survival percentage was achieved at 30°C. Sharma and Bhatnagar (2002) recorded 95% of survival for *R. maidis* on barley.

The female longevity was shorter at 30°C than at 25°C with the three tested aphids. Similar results were obtained by Elliott *et al.* (1988); Tasi and Liu (1998); Hwa and Yun (1999); McCornack *et al.* (2004) who reported that in many cases, aphid longevity decreased with higher temperatures. On the contrary with the longevity, the fecundity and fecundity rate were significantly higher at 25°C than at 30°C for the three aphid species. Foott (1977) mentioned that females of *R. maidis* produced 68.2 nymphs per female. On barley, the fecundity of *R. maidis* was 66.07 nymphs per female (Sharma and

Bhatnagar, 2002). Hong *et al.* (2002) pointed out the optimum temperature for growth, development, and fecundity of *R. maidis* was 25°C. El-Kady and Salem (1973) noted that on broad bean, the fecundity of *A. craccivora* was 42.4 nymphs per female, while Das and Dutta (1999) recorded 62.67 nymphs per female and 3.32 nymphs per female per day for the fecundity and fecundity rate for *A. craccivora*. Concerning *A. nerii*, Hwa and Yun (1999) concluded that the fecundity of females at 15, 20, and 25°C did not differ significantly with more than 12 offspring produced by each female. The obtained figures were less than those of fecundity and fecundity rate achieved in the present investigation, which may be due to differences in host plants or temperatures.

As shown by the results in this study, regression analysis indicated that female fecundity rate of *R. maidis* and *A. craccivora* at the two tested temperatures was gradually decreased as the age of the female increased. Similarly, the same trend was observed with those addressed by Xia et al. (1999) and McCornack et al. (2004). While, this relationship was not found with *A. nerii* at 25 and 30°C.

The findings in current study showed that the mean generation time (T) and doubling time (DT) of *R. maidis, A. craccivora*, and *A. nerii* were shorter at 30°C than at 25°C, while the intrinsic rate of increase (r_m) and finite rate of increase (λ) were higher. Meanwhile, the gross reproductive rate (GRR) and net reproductive rate (R_o) values were higher at 25°C than at 30°C for the three aphid species. According to Berg (1984) and Srikanth and Lakkundi (1988), *A. craccivora* showed a higher population growth potential at 25°C than the other temperatures. Hwa and Yun (1999) also concluded that the highest values of r_m and λ (0.1436 and 1.1575) for *A. nerii* was recorded at 25°C, while at 30°C, the shortest mean generation time (T) (11.8 days) was found. Similar results were achieved by Kersting *et al.* (1999) and Xia *et al.* (1999) on *Aphis gossypii* Glover; Tang et al. (1999) on *Toxoptera citricida* (Kirkaldy), Liu and Yue (2000) on *Lipaphis erysimi* (Kaltenbach), and McCornack *et al.* (2004) on *Aphis glycines* Matsumura (Table 5).

Table (5): Values of life table parameters of some aphid species reared at 25 and 30°C (Quoted from the literature).

Aphid species	Temp. °C	T	DT	GRR	R_o	r_m	λ	Reference
A. gossypii	25	-	-	-	44.7	0.337	-	Kersting *et al.* (1999)
	30	-	-	-	37.9	0.413	-	
A. gossypii	25	8.3	1.8	-	24.4	0.386	1.47	Xia *et al.* (1999)
	30	6.4	1.9	-	10.2	0.360	1.43	
T. citricida	25	11.2	2.1	46.2	42.0	0.33	1.39	Tang *et al.* (1999)
	30	9.4	2.2	30.9	20.3	0.32	1.38	
L. erysimi	25	12.2	1.9	-	83.58	0.3620	1.4362	Liu and Yue (2000)
	30	9.8	2.0	-	29.59	0.3454	1.4125	
A. glycines	25	9.76	1.46	72.96	-	0.474	1.606	McCornack *et al.* (2004)
	30	8.06	1.85	22.55	-	0.375	1.455	

It could be concluded from the present study that the most suitable temperature for aphid population growth was 30°C. These results may explain why the populations of the tested species significantly higher in April, May, August, and September than the other months in Egypt. In addition, the rate of increase of aphid species even at the lowest density is useful in portraying the principles of aphid population management by any control measure. Life table parameters at constant temperatures are also needed to construct models of predicting aphid outbreaks and to enhance the effect of various methods of suppression.

ACKNOWLEDGEMENT

Sincere appreciation is extended to Drs. A. M. Abou El-Naga, and A. A. Ghanim, Economic Entomology Department, Faculty of Agriculture, Mansoura University and to Dr. A. A. Donia, Economic Entomology and Pesticides Department, Faculty of Agriculture, Alexandria University for their valuable advise, comments, and critical revision of the manuscript.

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تأثير درجة الحرارة على بعض المقاييس البيولوجية وجداول الحياة لحشرات " منّ أوراق الذرة ومنّ البقوليات ومنّ التفلة"

عادل حسن عبد السلام

قسم الحشرات الإقتصادية – كلية الزراعة – جامعة المنصورة.

تم دراسة تأثير درجتى الحرارة ٢٥ ، ٣٠ °م على فترات النمو والبقاء وفترات الحياة ومقاييس جداول الحياة لحشرات" منّ أوراق الذرة ومنّ البقوليات ومنّ التفلة.

أظهرت النتائج عدم وجود فروق معنوية فى طول فترة النمو لأعمار الحورية الأربعة فى حشرة منّ أوراق الذرة بين درجتى الحرارة المختبرتين. بينما أظهرت نتائج التحليل الإحصائى وجود إختلافات معنوية فى فترة النمو لحوريات حشرتى "منّ البقوليات ومنّ التفلة". كما أوضحت النتائج أن نسبة وصول الحوريات لطور الحشرة الكاملة " Survival " إختلفت معنويا عند درجتى الحرارة لأنواع المنّ الثلاثة حيث كانت درجة الحرارة ٣٠ °م هى الأفضل فى الوصول لطور الحشرة الكامل. وقد إنخفضت فترة الحياة Longevity عند درجة الحرارة ٣٠ °م عنها عند درجة حرارة ٢٥ °م مع أنواع المنّ الثلاثة. وكذلك بينت النتائج وجود علاقة سلبية قوية بين عمر الإنثى Female age ومعدل الخصوبة Fecundity Rate لإناث حشرتى "منّ أوراق الذرة ومنّ البقوليات" أى أن الأنثى تلد بمعدل أكثر فى بداية وصولها لطور الحشرة الكاملة ، هذه العلاقة غير موجودة مع حشرة منّ التفلة وذلك على درجتى الحرارة المختبرتين.

وأظهرت النتائج أيضا أن قيم جدول الحياة المحسوبة لفترة الجيل (T) ، الزمن اللازم للتضاعف (DT) كانت أقصر على درجة الحرارة ٣٠ °م وأعلى فى قيمة معدل الزيادة الطبيعى (r_m) ،معدل الزيادة النهائى (λ) وقيم معدل الحياة (Lx) لأنواع المنّ الثلاثة على نفس درجة الحرارة. بينما كانت قيم معامل التضاعف (R_o)، معدل التكاثر (GRR) ومعدل ولادة الحوريات/ أنثى / يوم (Mx) مرتفعة على درجة الحرارة ٢٥ °م وذلك لأنواع المنّ الثلاثة. ونتائج هذه الدراسة يمكن إستخدامها فى وضع برامج المكافحة لتلك الآفات الحشرية الهامة على المحاصيل المختلفة وخاصة برامج المكافحة الحيوية على محاصيل الخضر التى تؤكل طازجة والتى يجب عدم وجود أى آثار متبقية للمبيدات عليها.