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Biological Aspects and Life Table Analysis of Cereal Aphid Species and their Parasitoid, *Aphidius colemani* Viereck (Hymenoptera: Aphidiidae)

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ABSTRACT

Theoretical predictions of the life tables are considered here for population of aphid species (*Rhopalosiphum padi* Linnaeus. and *Schizaphis graminum* Rondani) and their associated parasitoid (*Aphidius colemani* Viereck) using age specific survival and fecundity schedule. Almost all values of *R. padi* and *S. graminum* on barley outnumbered those on wheat. Results of life table analysis using *R. padi* and *S. graminum* on the wheat cultivars coded 3, 5 and 8 under the laboratory conditions (23±1°C and 60±5% R.H.), showed that cultivar coded 5 seemed to be the most resistant cultivar for both aphid species, among the tested three cultivars as well the check variety Sakha 69. The other two cultivars showed different susceptibility for the two cereal aphid species, cultivar coded 3 was more tolerant to the infestation than the cultivar coded 8 in case of *R. padi*, while it was *vice versa* in case of *S. graminum*. Results of life table analysis using the parasitoid *A. colemani* on *R. padi* and *S. graminum* on wheat and barley showed equal values for the parasitoid *A. colemani* on *R. padi* on both wheat and barley. All values of the parasitoid *A. colemani* on *S. graminum* on barley were higher than thos on wheat. Significant differences among the three different wheat cultivars were recorded when they were exposed to *R. padi* and /or *S. graminum* and *A. colemani*.

Key Words: Biological aspects, Life table, cereal aphids, parasitoids, *Aphidius colemani*, *Rhopalosiphum padi*, *Schizaphis graminum*

INTRODUCTION

Wheat (*Triticum aestivum* L., Fam.: Gramineae) is the major winter cereal crop in Egypt, widely distributed all over the country. It is constrained by a variety of insect pests, vertebrates and diseases. Aphids (Homoptera: Aphididae) are the serious insect pests attacking wheat plants, not only in Egypt but also, in many other countries. Aphids are also efficient vectors of different strains of plant viruses. Damage to the crop caused by aphids was estimated by up to 23%, particularly in Upper Egypt, where the highest infestation mostly occurs (Tantawi, 1985 and El- Heneidy *et al.*, 1991). In Egypt, *Rhopalosiphum padi* L., *R. maidis* Fitch, *Schizaphis graminum* Rond., *Sitobion avenae* Fab., are recorded as the main aphid species on wheat plants (El-Hariry, 1979); *R. padi* is the most abundant and important one (El- Heneidy, 1994).

Life table analysis can offer quantitative estimates of life history parameters that help interpreting the population dynamics and productivity to make effective management decisions for aphid species and their associated parasitoids in wheat field. The underlying assumptions and techniques vary according to the purpose of different studies (Hegazy 1992). The major problems in applying life tables to animal populations lie in sampling the mobile populations and accurately aging the individuals. These are not faced in aphid species and their parasitoid under laboratory conditions.

Aphidius colemani Viereck (Hymenoptera: Aphidiidae) is one of the most important primary parasitoid species of aphids. The host range of *A. colemani* is quite wide, and its hosts belong to the family Aphididae. Significant differences in the host range and preference for particular host species occur in some areas of the distribution range (Stary, 1975 and 1976).

Contributing to the importance of the aphid parasitoids, in particular *A. colemani* and their economic hosts, the present study estimates the parameters related to the populations growth potential of key cereal aphid species which may back up integrated management program for their control.

MATERIALS AND METHODS

Establishment of Host and Parasitoid Laboratory Cultures.

Seeds of wheat and barley were cultivated in small plastic pots, of 12x12cm^3. Pots were left till germination under muslin cages and greenhouse conditions (23±1°C, 60±5% R.H. and photoperiod 16L and 8D). Seedlings were separately infested by the two major cereal key aphid species, *R. padi* and *S. graminum*. The two aphid species were obtained from field samples. Parasitized aphids (mummies) were eliminated

daily. Infested pots with each aphid species were left under daily observation in the greenhouse to establish pure cultures from both species separately.

Alive parasitoid adults of *A. colemani* were obtained from the emerged parasitoids recovered from the field samples that kept in the jars under the laboratory conditions. Males and females of *A. colemani* recovered from the samples were allowed to mate in small glass vials and provided with droplets of honey to serve as food. An adequate number of aphids (early nymphal instars) were exposed to the mated females on wheat and/or barley potted seedlings. Pots were transferred to cages, of 30x30x30 cm, covered with muslin, to establish a laboratory pure culture from the target parasitoid species, *A. colemani.*

Biological Studies

Life table studies for both cereal aphid species; *R. padi* and *S. graminum* on tolerant and\or semi-resistant wheat cultivars, coded 3, 5, 8, were studied under the previously mentioned greenhouse conditions. Apterous viviporous females (adults) were collected from laboratory rearing cultures and placed on fresh wheat and/or barley seedlings. The seedling pot was placed in a cylindrical shaped plastic, open ended from the two sides and closed with muslin and rubber bands after placing the infested seedling pot with aphids. New born progenies (first instars nymphs) laid by these mothers were transferred individually on one week-old seedlings of the commercial wheat variety (Sakha 69) and barley (Giza 124) using a camel's hair brush. Transferred nymphs were observed daily to record the following biological data:

-Periods elapsed between successive molts by removing cast skin regularly.
-Duration of a generation, as the time elapsed between birth and first parturition.
-The fraction of progeny reached maturity.
-Sex ratio, considered as one, since all progeny developed to females (parthenogenesis).
-Survival of individuals throughout their developmental duration.

Life table studies for *A. colemani* on cereal aphid species; *R. padi* and *S. graminum* were studied under laboratory conditions. Fertilized (mated) females were exposed individually every 24 hours to 100 healthy aphids of 2nd and 3rd nymphal instars of the two species on wheat and/or barley seedlings, separately. Females were provided by droplets of honey. Females were removed daily to be exposed to new 100 aphids until death. Parasitized aphids were dissected (every 24 hours) for counting number of parasitoid eggs per female. Formed mummies were collected into separate vials. Recorded data included number of mummies, percentage of emergency and sex ratio. The same experiment was repeated on tolerant and/or semi-resistant wheat cultivars coded 3, 5, 8 for 24 hours only.

Statistical analysis

Life table biological parameters were described by (El-Fatih, 2000). The life expectancy table included: number of survivors (Lx), number of dead individuals, age of structure and life expectancy. The fertility table included the net reproductive rate (Ro), time interval between generation (T), intrinsic rate of population increase (r_m), finite rate of increase (exp. r_m) and time needed for the population to double in size, by means of age intervals (x), age-specific fecundity (m_x) and age-specific survivorship (l_x), where: $Ro = \sum (m_x l_x)$; $T = (\sum m_x l_x x)/ \sum (m_x l_x)$; $r_m = \log_e Ro/T$; exp. $r_m = e^{rm}$; and generation doubling time = $\ln(2)/r_m$.

Analysis of the life table study was analyzed following Birch (1948), using life 48 Basic Computer Program (Birch 1948 and Abou-Setta *et al.,* 1986), and Statistical Analyses System SAS Institute SAS/ATAT (1988).

RESULTS AND DISCUSSION

Biological aspects of aphids

Life table parameter results for *R. padi* and *S. graminum* on wheat, check variety Sakha 69 and on barley, check variety Giza 124 under laboratory conditions of 23±1°C and 60±5% R.H., are presented in Table (1). Expected progeny per female per day and survivorship rate are illustrated graphically in Figure (1).

The mean durations of the first, second, third, fourth instars and life span of *R. padi* averaged 1.19±0.45, 1.09±0.28, 1.17±0.43, 1.28±0.45 and 21.19 days, respectively on wheat and 1±0, 1.17±0.38, 1±0, 1.36±0.49 and 23.82 days, respectively on barley. Percentage of progeny of *R. padi* on wheat, and on barley, reached maturity was 96 and 100%, respectively. Respective mean generation time (T) was 10.88 and 9.62 days. The net reproductive rate (R_o) and the intrinsic rate of increase (r_m) were 58.32 and 0.37 on wheat and 63.83 and

0.43 on barley, respectively. Correspondent finite rate of increase (exp. r_m) was 1.45 and 1.54, while the generation doubling time was 1.85 and 1.61 days. Almost all values of *R. padi* on barley, check variety Giza 124, outnumbered those on wheat, check variety Sakha 69. Mohamed (1992) reported that *R. padi* passes the nymphal stage through four instars. The total developmental period of *R. padi* immature stages averaged 9.41-7.76 days, when insect reared under normal conditions of (13-16°C) and 55.5-60% R.H.

Table (1): Life table parameters (mean±SD, range) of *Rhopalosiphum padi* and *Schizaphis graminum* on wheat check variety, Sakha 69 and barley check variety, Giza 124 under laboratory conditions of 23±1°C and 60±5% R.H.

Aphid species	*R. padi*		*S. graminum*	
Parameters	Wheat	Barley	Wheat	Barley
First nymphal instar	1.19±0.45 (1-3)	1±0 (1-1)	1.68±0.47 (1-2)	1± 0 (1-1)
second nymphal instar	1.09±0.43 (1-3)	1.17±0.38 (1-2)	1.41±0.65 (1-3)	1.17±0.38 (1-2)
Third nymphal instar	1.17±0.43 (1-3)	1± 0 (1-1)	1.55±0.75 (1-4)	1± 0 (1-1)
Fourth nymphal instar	1.28±0.45 (1-2)	1.36±0.49 (1-2)	1.64±0.61 (1-3)	1.36±0.49 (1-2)
Life span	21.19 (7-30)	23.82 (8-35)	18.2 (9-33)	32.85 (10-34)
Generation time	6.25	5.81	8.4	6.74
Mean generation time (T)	10.88	9.62	13.93	11.45
Survival rate to maturity	96%	100%	53%	85%
Net reproductive rate (Ro)	58.32	63.83	14.59	36.75
The intrinsic rate of increase (r_m)	0.37	0.43	0.19	0.32
The finite rate of increase (exp. r_m)	1.45	1.54	1.21	1.37
Generation doubling time*	1.85	1.61	3.6	2.2

(*)= ln 2/ r_m

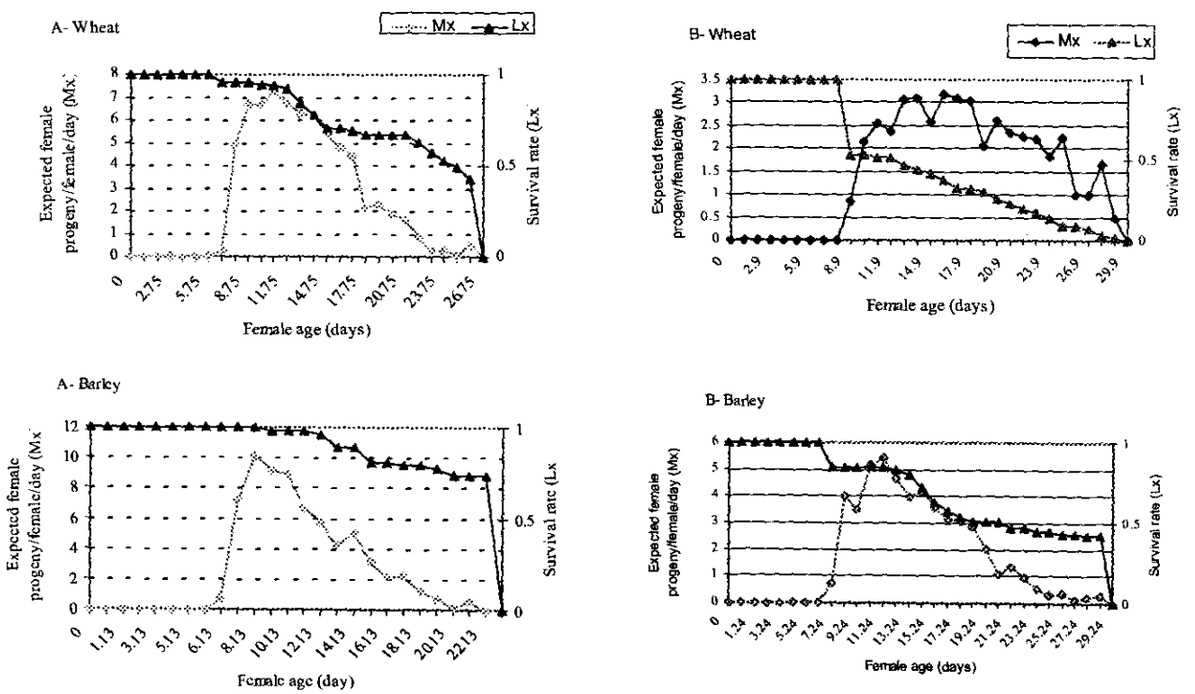


Fig (1): Age specific fecundity (Mx) and survival rate (Lx) of *R. padi* (A) and *S. graminum* (B) on wheat check variety, Sakha 69 and barley check variety, Giza 124, under laboratory conditions, of 23+1°C and 60+5% R.H..

The mean durations of the first, second, third, fourth instars and life span of *S. graminum* 1.63±0.47, 1.41±0.65, 1.55±0.75, 1.64±0.61 and 18.20 days, respectively on wheat and 1±0, 1.17±0.38, 1±0, 1.36±0.49 and 23.85 days, respectively on barley. Respective data of *S. graminum* on wheat, check variety Sakha 69 and on barley, check variety Giza 124, concerning the percentage of progeny reached maturity were 53 and 85%, respectively. Correspondent mean generation time (T) was 13.93 and 11.45 days. While the net reproductive rate (R_o) and the intrinsic rate of increase (r_m) were14.59 and 36.75 and 0.19 and 0.32, respectively. The finite rate of increase (exp. r_m) was 1.21 and 1.37, while the generation doubling time was 3.6 and 2.20 days. Almost all values of *S. graminum* on barley, check variety Giza 124, outnumbered those on wheat, check variety Sakha 69. El-Gantiry (1999) studying the biology and life table of *S. graminum* on the wheat, under constant temperatures of 17, 20, 25 and 28°C and relative humidity percentage of 70±5% reported that the life cycle, life span and viviparity durations were 97.375, 11.94 and 5.38 days), respectively.

Therefore, data obtained at constant temperatures (laboratory) can be utilized to estimate development time for these insects that would provide supporting information for management strategies against these pests.

Influence of host plant resistance on biological aspects of cereal aphids.

Life table parameter results for *R. padi* and *S. graminum* on the wheat cultivars coded 3, 5 and 8 under the laboratory conditions are presented in Table (2). Expected progeny per female per day and survivorship rate are illustrated graphically in Figures 2 and 3.

Table (2): Life table parameters (mean±SD, range) of *Rhopalosiphum padi* and *Schizaphis graminum* on wheat cultivars coded 3, 5, and 8 under laboratory conditions of 23±1°C and 60±5% R.H.

Aphid species	*R. padi*			*S. graminum*		
	Wheat cultivars			Wheat cultivars		
Parameters	C3	C5	C8	C3	C5	C8
First nymphal instar	2±0 (2-2)	1.9±0.35 (1-2)	2±0 (2-2)	1.65±0.49 (1-2)	1.95±0.61 (1-3)	1.65±0.59 (1-3)
second nymphal instar	1.4±0.52 (1-2)	1.5±0.71 (1-3)	1.1±0.32 (1-2)	1.95±0.69 (1-3)	2.22±0.88 (1-4)	2.26±0.87 (1-4)
Third nymphal instar	1.3±0.48 (1-2)	1.6±0.52 (1-2)	2.1±0.32 (2-3)	1.67±0.59 (1-4)	1.93±0.63 (1-4)	2.07±0.53 (1-4)
Fourth nymphal instar	2±0.67 (1-3)	1.4±0.52 (1-2)	1.9±0.32 (1-2)	1.72±0.75 (1-3)	2±0.85 (1-3)	1.79±0.58 (1-3)
Life span	22.5 (8-40)	22.6 (8-40)	25.3 (10-38)	19.5 (10-41)	20.27 (10-37)	17.57 (10-33)
Generation time	7.7	7.8	8.1	8.5	8.89	7.6
Mean generation time (T)	12.62	13.04	12.54	14.26	15.11	13.2
Survival rate to maturity	100%	100%	100%	78.20%	40.70%	54%
Net reproductive rate (Ro)	53.3	50.1	56.4	23.81	12.06	14.33
The intrinsic rate of increase (rm)	0.32	0.3	0.32	0.22	0.17	0.2
The finite rate of increase (exp. rm)	1.37	1.35	1.38	1.25	1.18	1.22
Generation doubling time*	2.2	2.31	2.16	3.12	4.21	3.44

(*)= $\ln 2 / r_m$

The mean durations of the first, second, third, fourth instars and life span of *R. padi* averaged 2±0, 1.4±0.52, 1.3±0.48, 2±0.67, and 22.5 days, respectively on the wheat cultivar coded 3, 1.9±0.35, 1.5±0.71, 1.6±0.52, 1.4±0.52 and 22.6 days, respectively on the wheat cultivar coded 5 and 2±0, 1.1±0.32, 2.1±0.32, 1.9±0.32 and 25.3, respectively on the wheat cultivar coded 8. As well, percentage of progeny of *R. padi* on the wheat cultivars coded 3, 5 and 8, reached maturity was 100%. Respective mean generation time (T) was

12.62, 13.04 and 12.54 days, while the net reproductive rate (R_o) and the intrinsic rate of increase (r_m) were 53.3, 50.1 and 56.4 & 0.32, 0.30 and 0.32, respectively. The finite rate of increase (exp. r_m) was 1.37, 1.35 and 1.38, while the generation doubling time was 2.2, 2.309 and 2.16 days, respectively. Highest values on *R. padi* were recorded on the wheat cultivar, coded 8 then 3 and lastly 5.

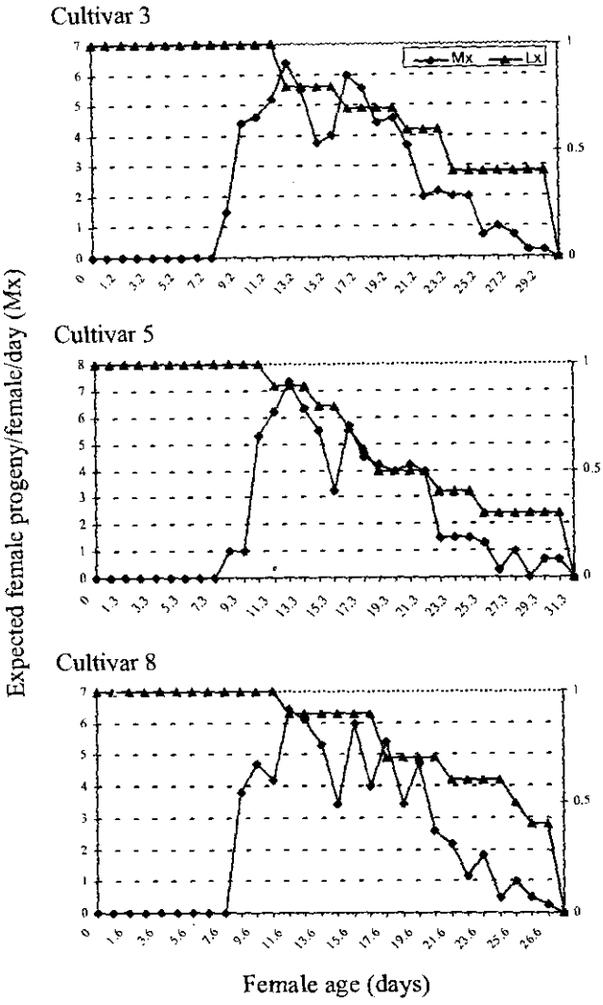


Fig (2): Age specific fecundity (Mx) and survival rate (Lx) of *R. padi* on wheat and 60+5% R.H

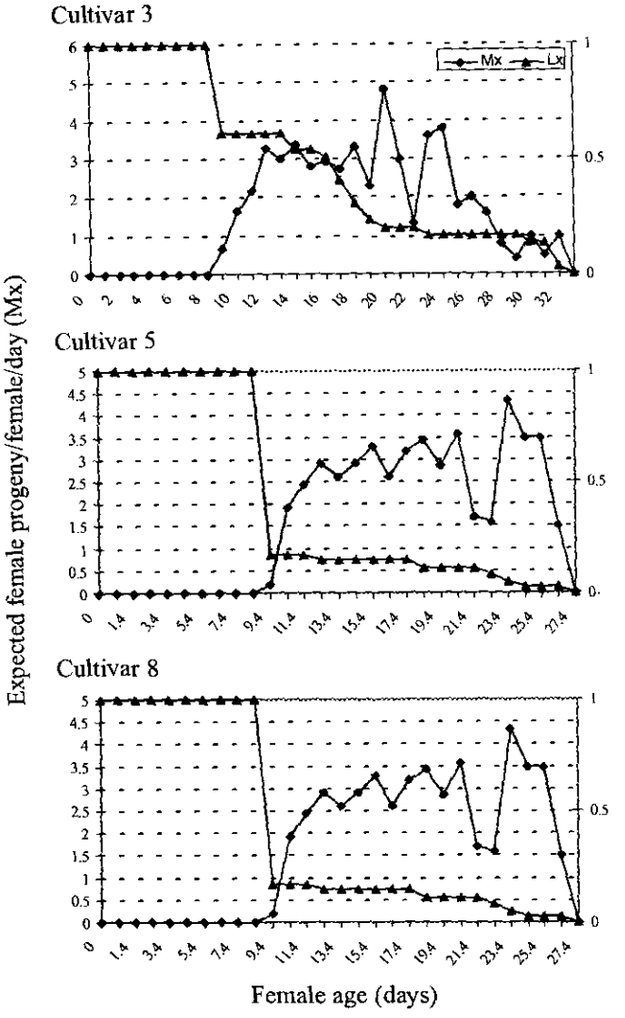


Fig (3): Age specific fecundity (Mx) and survival rate (Lx) of *S. graminum* on wheat cultivars coded 3, 5 and 8, under laboratory conditions of 23+1oC and 60+5% R.H.

The mean durations of the first, second, third, fourth instars and life span of *S. graminum* averaged 1.65±0.49, 1.95±0.69, 1.67±0.59, 1.72±0.75, and 19.5 days, respectively on the wheat cultivar coded 3, 1.95±0.61, 2.22±0.88, 1.93±0.63, 2±0.85, and 20.27 days, respectively on the wheat cultivar coded 5 and 1.65±0.59, 2.26±0.87, 2.07±0.53, 1.79±0.58 and 17.75 days, respectively on the wheat cultivar coded 8. Percentage of progeny of *S. graminum* on the wheat cultivar coded 3, 5 and 8 reached maturity was 78.2, 40.7 and 54%, respectively. Respective mean generation time (T) was 14.26, 15.11 and 13.20 days, while the net reproductive rate (R_o) and the intrinsic rate of increase (r_m) were 23.81, 12.06 and 14.33 and 0.22, 0.17 and 0.20, respectively. The finite rate of increase (exp. r_m) was 1.25, 1.18 and 1.22, while the generation doubling time was 3.12, 4.21 and 3.44 days, respectively. Highest values of *S. graminum* were recorded on the wheat cultivar coded 3 then 8 and lastly 5.

It could be concluded from the obtained results and daily observations that the wheat cultivar coded 5 seemed to be the most resistant cultivar for both aphid species, *R. padi* and *S. graminum* among the tested three cultivars as well the check variety Sakha 69. While the other two cultivars showed different susceptibility for the two cereal aphid species, cultivar coded 3 was more tolerant to infestation than the

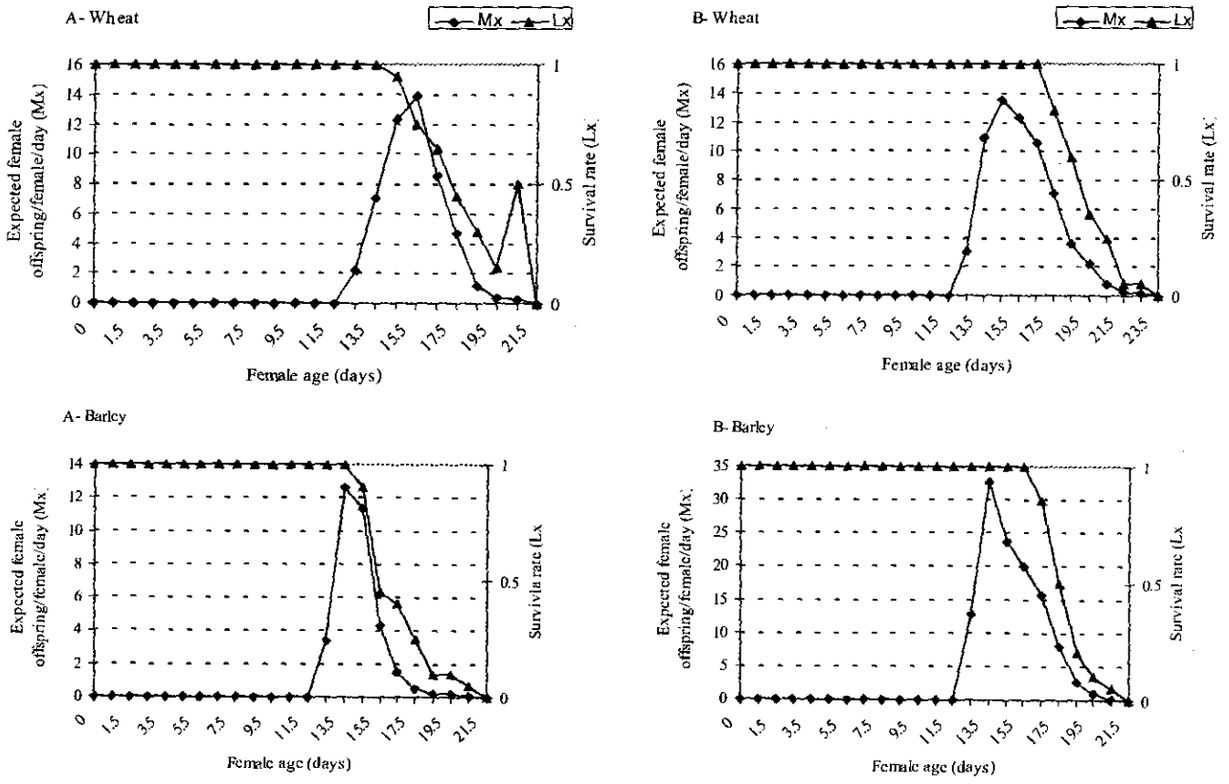
cultivar coded 8 in case of *R. padi* while it was *vice versa* in case of *S. graminum*. These results agree with the findings of El-Gantiry *et al.* (1999) and El-Fatih (2000).

Biological aspects of the parasitoid *Aphidius colemani*

Life table parameter results for the parasitoid *A. colemani* on both *R. padi* and *S. graminum* on the wheat check variety, Sakha 69 and the barley check variety, Giza 124, under the laboratory conditions are summarized in Table (3). Expected offspring per female per day and survivorship rate are illustrated graphically in Figure (4). Durations of the egg, first, second, third instars, prepupa, and pupa on *R. padi* reached 54, 54, 30, 36, 42 and 78 hours, on wheat and 48, 60, 30, 24, 42, and 72 hours, on barley, respectively. Mean generation time (T) of parasitoid *A. colemani* on *R. padi* on wheat and barley, was 14.75 and 13.86 days, respectively. The net reproductive rate (R_o) and the intrinsic rate of increase (r_m) were 39.47 and 28.94 & 0.25 and 0.24, respectively. The finite rate of increase (exp. r_m) was 1.28 and 1.28, while the generation doubling time was 2.78 and 2.86 days. Equal values were obtained for the parasitoid *A. colemani* on *R. padi* on both wheat and barley.

Table (3): Life table parameters of *Aphidius colemani* on *Rhopalosiphum padi* and *Schizaphis graminum* on wheat check variety, Sakha 69 and barley check variety, Giza 124 under laboratory conditions of 23±1°C and 60±5% R.H.

Aphid species	*R. padi*		*S. graminum*	
Parameters	Wheat	Barley	Wheat	Barley
Generation time	12	12	12	12
Mean generation time (T)	14.75	13.86	14.97	14.24
Net reproductive rate (Ro)	39.47	28.94	59.22	107.25
The intrinsic rate of increase (rm)	0.25	0.24	0.28	0.33
The finite rate of increase (exp. rm)	1.28	1.28	1.31	1.39
Generation doubling time	2.78	2.86	2.54	2.11



Fig(4): Age specific fecundity (Mx) and survival rate (Lx) of *A. colemani* on *R. padi* (A) and *S. graminum* (B) on wheat check variety, Sakha 69 and barley check variety, Giza 124, under laboratory conditions, of 23+1°C and 60+5% R.H.

The durations of the egg, first, second, third instars, prepupa, and pupa on *S. graminum* were 48, 54, 30, 48, 36 and 84 hours, on wheat and 48, 54, 24, 42, 42 and 78 hours on barley, respectively. The mean generation time (T) of parasitoid *A. colemani* on *S. graminum* on wheat and barley was 14.97 and 14.24 days, respectively. The net reproductive rate (R_o) and the intrinsic rate of increase (r_m) were 59.22 and 107.25 & 0.27 and 0.33, respectively. The finite rate of increase (exp. r_m) was 1.31 and 1.39, while the generation doubling time was 2.54 and 2.11 days. Almost all values of the parasitoid *A. colemani* on barley were higher than those on wheat.

Reed *et al.* (1992) developed cohort life tables in the laboratory for *Diuraphis rapae*, imported into the USA from Asia, on *Diuraphis noxia*. Female began to oviposit at age 13 days. Age-specific fecundity peaked at approximately18 eggs/female at 15 days. The overall sex ratio of progeny was more strongly female biased (66.95). The net reproductive rate as 58.6% female offspring/female. The mean age at death was 19.7 days. The intrinsic rate of increase was (0.263). Steenis and Van-Steenis (1993) studied development of *A. colemani* with *Aphis gossypii* as host. The intrinsic rate of increase of the parasitoid at 20 and at 25°C was comparable to the intrinsic rate of increase of *A. gossypii*. Masum *et al.* (1997), investigated life table of *A. colemani*, a parasitoid of *Aphis fabae* and mentioned that gross reproductive rate and net reproductive rate were greatest at 20°C, but capacity and intrinsic rate of increase were greatest at 25°C. The development time was also shortest at 25°C.Thus, temperature had a considerable influence on the life cycle of this parasitoid, and the optimum temperature for utilizing this parasitoid as an efficient bio-control agent was around 25°C, although many other environmental factors could influence its effectiveness in the field.

The information from the biological aspects and fertility tables are important for studies involving population dynamics of these aphids, allowing the estimation of aspects related to its population growth potential, in order to provide background knowledge for management strategies against these pest insects.

Influence of host plant resistant on biological aspects of *A. colemani*

Host plant resistance phenomenon was studied in both cereal aphid species; *R. padi* and *S. graminum* when the two species were exposed separately to *A. colemani* under the laboratory conditions of 23±1°C and 60±5%R.H. Obtained data are presented in Table (4). In case of *R. padi*, mean number of mummies, adults emerged, percentage of emergence and sex ratio reached 41.2±13.12, 37±12, 92.16±10.78 and 2.8:1, 25.6±11.71, 25±10.49, 99.02±2.19 and 2.7:1, and 17.4±5.6, 16±5.10, 89.46±11.96 and 1.3:1 on the wheat cultivars 3, 5 and 8, respectively. Correspondent values in case of *S. graminum* were 44.8±12.80, 40±14.14, 89.54±4.69 and 2.6:1, 22.2±10.16, 19.8±10.66, 91.62±6.37 and 2.5:1, and 25.8±11.15, 23.4±9.44, 92.36±5.99 and 0.9:1, respectively.

Table (4): Mean number of mummies, mean number of adults emerged, % emergence and sex ratio of *Aphidius colemani* on *R. padi* and *S. graminum* reared on different wheat cultivars under laboratory conditions

Aphid species	Mean no. of		% Emergence	Mean no. of		Sex ratio
	mummies	adults emerged		Female	Male	(F:M)
C3-*R. padi*	41.2±13.12	37±12	92.16±10.78	25.4±9.84	11.6±8.65	2.8:1
C5-*R. padi*	25.6±11.71	25±10.49	99.02±2.19	17.4±15.53	7.6±5.37	2.7:1
C8-*R. padi*	17.4±5.6	16±5.10	89.46±11.96	9.4±10.36	6.6±4.98	1.3:1
C3-*S. graminum*	44.8±12.80	40±14.14	89.54±4.69	29±11.11	11±3.39	2.6:1
C5-*S. graminum*	22.2±10.16	19.8±10.66	91.62±6.37	14±8.15	5.8±3.03	2.5:1
C8-*S. graminum*	25.8±11.15	23.4±9.44	92.36±5.99	9.8±6.22	13.6±8.20	0.9:1

Statistical analyses showed significant differences among the three different wheat cultivars when exposed to *R. padi* and/or *S. graminum* and *A. colemani* separately. The mean number of mummies in cultivar 3 was significant in both cases on *R. padi* and/or *S. graminum* but insignificant in case of the other

two cultivars. Mean number of adults emerged in cultivar 3 was significant in both cases on *R. padi* and/or *S. graminum* but insignificant in the other two cultivars. Emergence (%) was insignificant among the three cultivars and the two aphid species.

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اعتبارات بيولوجية وتحليل جداول الحياة لأنواع مَن الحبوب وطفيله
Aphidius colemani Viereck (Hymenoptera: Aphidiidae)

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استخدمت التنبؤات النظرية لجداول حياة تعداد أنواع المن *Rhopalosiphum padi* L. وطفيلها المصاحب *Aphidius colemani* Vireek. (Hymenoptera: Aphidiidae) و *Schazaphis graminum* Rond. باستخدام جداول القدرة البقائية العمرية والخصوبة. تفوقت معظم قيم نوعى المَن *R. padi* و *S. graminum* على الشعير عن مثيلاتها على القمح. أوضحت نتائج تحليل جداول الحياة باستخدام نوعى المَن على سلالات قمح تحمل الأرقام الكودية ٣، ٥، ٨ تحت الظروف المعملية (٢٣ ± ١° م و ٦٠ ± ٥% رطوبة نسبية) أن سلالات كود ٥ بدت الأكثر مقاومة لكل من نوعى المَن بين السلالات الثلاث

المختبرة وكذلك الصنف المقارن سخا٦٩٠ كذلك أوضحت السلالتان الأخرتان قابلية مختلفة للإصابة بنوعى مَن الحبوب، حيث كانت السلالة كود ٣ اكثر تحملاً للإصابة عن السلالة كود ٨ فى حالة النوع *R. padi* بينما كان العكس صحيحا فى حالة النوع *S. graminum*. أوضحت نتائج تحليل جداول الحياة بإستخدام الطفيل *A. colemani* على كل من *R. padi* و *S. graminum* على القمح والشعير قيم متساوية للطفيل على النوع *R.. padi* على القمح والشعير٠ بينما كانت قيم الطفيل على النوع *S. graminum* أعلى على الشعير منها على القمح٠ سجلت اختلافات معنوية بين سلالات القمح المختلفة عند تعريضهم إلى كل من نوعى المن *R. padi* و *S. graminum* والطفيل *A. colemani*.