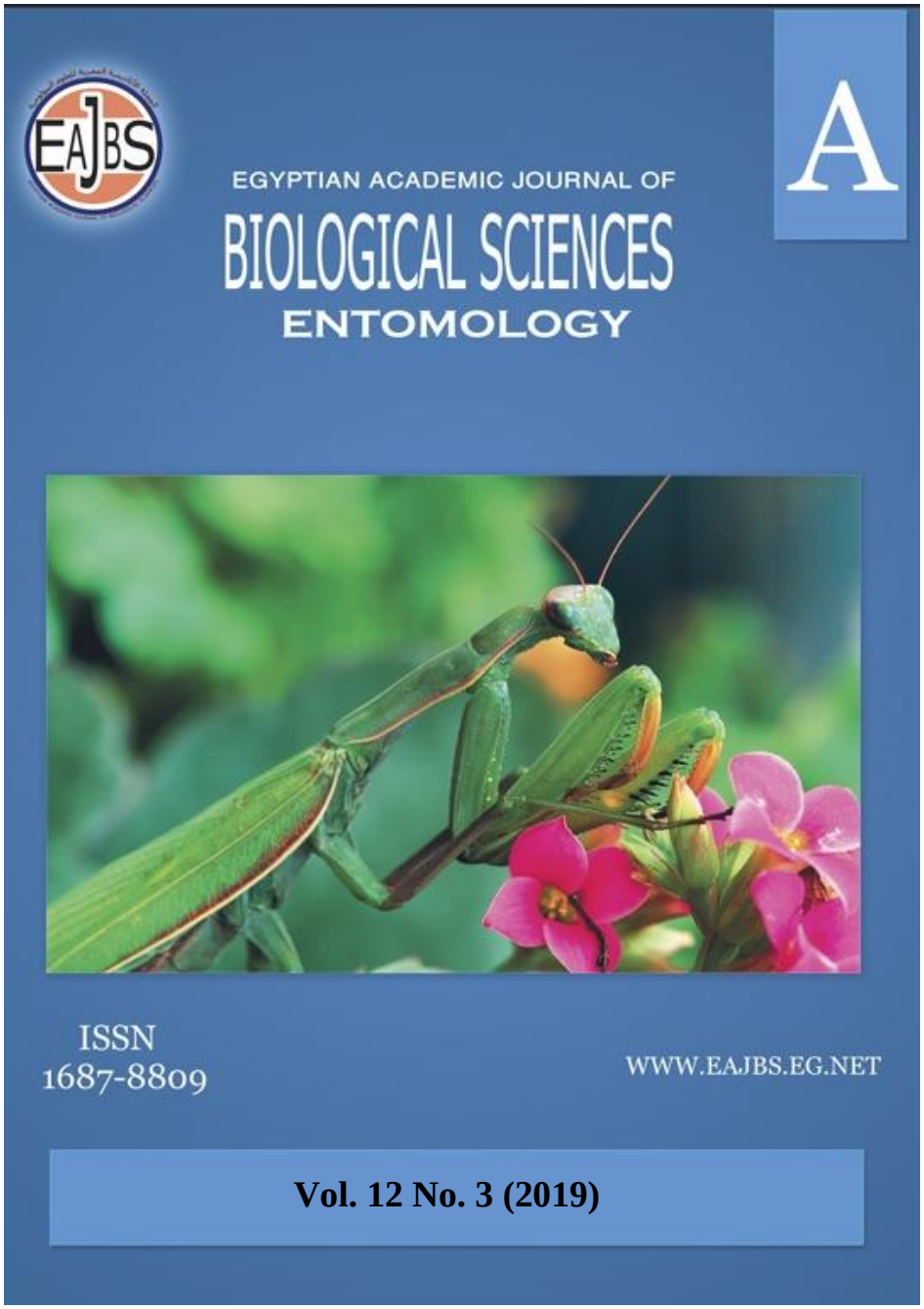


Egyptian Academic Journal of Biological Sciences is the official English language journal of the Egyptian Society for Biological Sciences, Department of Entomology, Faculty of Sciences Ain Shams University.

Entomology Journal publishes original research papers and reviews from any entomological discipline or from directly allied fields in ecology, behavioral biology, physiology, biochemistry, development, genetics, systematics, morphology, evolution, control of insects, arachnids, and general entomology.

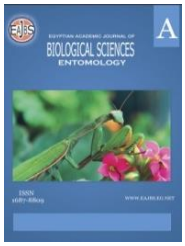
www.eajbs.eg.net

Citation: *Egypt. Acad. J. Biolog. Sci. (A. Entomology) Vol. 12(3) pp: 37- 47 (2019)*

Egypt. Acad. J. Biolog. Sci., 12(3):37– 47(2019)

Egyptian Academic Journal of Biological Sciences
A. Entomology

ISSN 1687- 8809
http://eajbsa.journals.ekb.eg/



Stage-specific Life Table Parameters of *Coccinella septempunctata* Linnaeus and *Coccinella undecimpunctata* Linnaeus (Coleoptera: Coccinellidae) on Different Host Species under Laboratory Conditions

Adnan Abdel-Fattah El-Sayed Darwish
Plant Protection Department, Faculty of Agriculture, Damanhour University, Egypt
Email: adnandarwish2012@yahoo.com or adnan.darwish@damanhour.edu.eg

ARTICLE INFO
Article History
Received:26/4/2019
Accepted:10/5/2019

Keywords:
Coccinella undecimpunctata; *Coccinella septempunctata* ;Life table; Stage specific; K-value; Survivor rate

ABSTRACT

The ladybird beetles (adults and larvae) are important predatory insects in most crops. They are voracious predators of aphids, scale insects, psyllids, jassids, thrips and whiteflies. The life table studies often use to describe the mortality rates, mortality survivor ratio and the further life expectation for successive age intervals. In this work the stage-specific life table parameters of *Coccinella septempunctata* Linnaeus and *Coccinella undecimpunctata* Linnaeus (Coleoptera: Coccinellidae) at four different hosts viz., *Myzus persicae*, *Aphis gossypii*, *Rhopalosiphum padi* and *Thrips tabaci* was constructed under the laboratory conditions. The developmental stages of *C. septempunctata* and *C. undecimpunctata* exhibited the highest apparent mortality, real mortality, mortality survivor ratio and total generation mortality (K value) in case of rearing on *T. tabaci* compared to those reared on *R. padi*, *M. persicae* and *A. gossypii*. On the other hand, the developmental stages of the two predators showed the highest survival ratio on *A. gossypii* compared to other preys. Larval mortality was greater in 1st instar than all other instars on the different hosts. The result further revealed that the minimum duration periods of the total larval development of *C. septempunctata* and *C. undecimpunctata* larvae were observed when the larvae fed with *A. gossypii* followed by *M. persicae*, *R. padi* and finally *T. tabaci*. The data on life table parameters indicated that among four different hosts the cotton aphids, *A. gossypii* has been proved as a most preferable and suitable prey for the development of *C. septempunctata* and *C. undecimpunctata*.

INTRODUCTION

Biological control one of the components of integrated pest management programs. The biological control agents (natural enemies) of insect pests include both of pathogens, parasitoids and predators (Jamie C. Abrams, 1990). Ladybird beetles (lady beetles or ladybugs) are a well-known group of insect predators. Both adults and larvae of ladybird beetles have a predatory nature against many insect pests, including aphids, scale insects, psyllids, jassids, thrips, whiteflies and small larvae (Ali, and Rizvi, 2007a; Ali and Rizvi, 2009; Ali, *et al*., 2009 and Kundoo and Khan, 2017). Among the different species of ladybird beetles, *Coocinella septempunctata* and *Coccinella undecimpunctata* are two of the most common insect predators in Egypt (Mahyoub, 2013 and Imam, 2015).

In entomology, where the mortality rates may vary from one developmental stage to another and these developmental stages are detached, the life table is an especially useful approach. It aids in analyzing the mortality of insect population and generates summary statistics such as life expectancy (Kakde, 2014). There are two different types of life tables: age-specific (horizontal, cohort) and time-specific (vertical, static) life table. In insect ecology the most common type of life table is the horizontal (age-specific) life table which based on recording the survival and reproduction of a single observed cohort of individuals from the time it is oviposited as a group of eggs until dying of the last adult (Bellows and Van Driesche, 1999; Chi and Yang, 2003 and Sahito, *et al*. 2017). The age-specific (horizontal) life tables provide a summary of mortality and reproductive schedules and can help clarify why certain species increase or decrease in a specific environment (Afrane *et al.*, 2007). The study of life-table of the predators at different hosts gives an important task for pest management in different conditions (Ali and Rizvi, 2009). The predator populations are affected by changes in prey populations and depend on prey for its survival (Arshad Ali, 2008). The present studies were planned to determine the life table parameters of *C. septempunctata* and *C. undecimpunctata* on different host species i.e. *Myzus persicae*, *Aphis gossypii*, *Rhopalosiphum padi* and *Thrips tabaci* under the laboratory conditions.

MATERIALS AND METHODS

The 1st Generation:

To obtain the eggs of the two predators *Coccinella septempunctata* and *Coccinella undecimpunctata*, the beetles of each predator were collected from the fields and put in cubicular wooden cages (25 * 25 * 25) in the laboratory. The wooden cages were constructed for rearing purposes, covered with a wire mesh sieve on each side, and the front had a hole by muslin cloth to provide food and collect the eggs. Fresh aphid infested tomato leaves were provided daily as food to the beetles. The eggs deposited by the females were removed with a fine camel-hair brush and allowed to hatch at a laboratory conditions (25°C ± 2°C with a photoperiod of 14L: 10D) in a Petri dishes having a circular paper spread over the bottom.

Feeding on the Different Four Hosts:

After egg hatching, the hatched larvae of each predator were divided into four portions and every portion was reared in glass jars with one of the different four hosts at the same laboratory conditions. The tested hosts were as follows; green peach aphids, *Myzus persicae*, cotton aphids, *Aphis gossypii*, bird cherry-oat aphids, *Rhopalosiphum padi* and onion thrps, *Thrips tabaci*. These procedures were followed till pupation.

The 2nd Generation:

After the emergence of adults (male and female), they also were provided with the same preys in sixteen replicates (four replicates for each prey) till obtain the eggs of the 2nd generation for study the stage-specific life table parameters of *C, septempunctata* and *C. undecimpunctata* on the above mentioned prey species with similar procedures.

Fifty freshly eggs (zero day old eggs) laid by females of each predator were obtained from the walls of the cubicular wooden cages and transferred to glass Petri dishes in sixteen replicates (four replicates for each prey). Hatching percentages were recorded for each replicate. The newly hatched larvae (1st instar larvae) were collected with a fine camel-hair brush and placed directly with one of a prey species (*Myzus persicae*, *Aphis gossypii*, *Rhopalosiphum padi* and *Thrips tabaci*) in new glass jars. For each predator species, sixteen glass jars were used (four replicates for each prey species). After moulting, the alive larvae of the 2nd larval instar were transferred to another sixteen glass jars with the same prey species then 16 replicates for the 3rd instar and another one for the 4th larval instar. Each larval instar was provided with a known number of preys (nymphs and adults) for feeding. The number of

preys was increased daily and as the larvae entered the next instar. After pupation, the pupa transferred to another sixteen glass jars (replicates) and the emergence adults (male and female) were recorded.

Observations on numbers of alive and dead, out of fifty eggs were recorded daily. The following assumptions were used in the construction of stage-specific life-table of *C. septempunctata* and *C. undecimpunctata*, as per suggestions of Birch (1948) and Southwood, 1978:

Life Table Construction:

(X) = Age unit

(I_x) = Number of individuals in specific age unit X

(d_x) = Number of dead individual (mortality) in specific age unit, $d_x=I_{x1}-I_{x2}$

(L_x) = Average number of individuals between two ages**,** $L_x= (I_{x1}+I_{x2})/2$

(T_x) =Total number of individuals at aged X and beyond, $T_x= L_{x1} +L_{x2} +L_{x3} \ldots. +L_{xn}$

(E_x) = Expectation of mean life for individuals of age x**,** $(E_x) = T_x / I_x$

(% A.M.) = Apparent Mortality (number of dying insects as a percentage of the number entering that stage), % A.M.**=** d_{xn} / I_{xn}

(% R.M.) = Real Mortality (number of dying insects as percentage of number eggs), (% R.M.) = d_{xn}/I_{x1}

(MSR)= Mortality Survivor Ratio (The increase in insect population that would have occurred if the mortality in the stage had not occurred), Mortality Survivor Ratio of specific stage= d_x in specific stage / l_x of subsequent stage

(IM) = Indispensable mortality (the mortality that wouldn't be if the factors causing it is not allowed to be effective, **I**ndispensable **M**ortality = [Number of emerged adults] x [Mortality Survivor Ratio of a particular stage]

S_x = Survivor rate, $S_x= I_{x2}/I_{x1}$

K-value = Loss individuals at beginning and the end of a particular stage, K-value **=** $Log.I_{x1}-Log.I_{x2}$

Total K-value = $K_{egg} + K_{1st\ instar} + K_{2nd\ instar} + K_{3rd\ instar} + K_{4th\ instar} + K_{pupa} + K_{Adults}$.

RESULTS

In the present study, the life tables of *Coccinella septempunctata* and *Coccinella undecimpunctata* on four different hosts; *M. persicae*, *A. gossypii*, *R. padi* and *T. tabaci* were evaluated under the laboratory conditions. The results showed that both *C. septempunctata* and *C. undecimpunctata* were able to develop and reach the adult stage when fed on each of the mentioned preys. The development stages of *C. septempunctata* and *C. undecimpunctata* consisted of an egg stage, four larval instars and a pupal stage.

The Eleven-Spot Ladybird, *Coccinella undecimpunctata*:

Apparent Mortality:

The life table indicated that the stage-specific mortalities of *C. undecimpunctata*, which reared on different hosts, were recorded in all life stages (egg – larva –pupa –adult). The apparent mortality refers to the number of dying insects as a percent of the numbers that entering a particular stage. During the egg stage of *C. undecimpunctata*, the apparent mortality was observed maximum (26.5 %) at *T. tabaci* (Table 4) and minimum (14 %) at *A. gossypii* (Table 2). When a comparison was made between larval instars, the highest apparent mortality (26.53 %) was recorded at 1st instar at *T. tabaci* (Table 2), while the lowest apparent mortality (5.83 %) was recorded at *A. gossypii* (3rd larval instar). Similarly, the apparent mortality at pupal stage remained maximum (16.36 %) at *T. tabaci* (Table 4), and minimum (11.02 %) at *A. gossypii* (Table 2).

Survival Rate (S_x):

The survival fraction (S_x) of *C. undecimpunctata* at egg stage recorded minimum value (0.735) in case of *T. tabaci* and maximum value (0.86) at *A. gossypii*. While considering larval instars, the survival rates (S_x) were lower in earlier instars as compared to the later instars. Minimum survival fraction was observed in 1st instar (at *T. tabaci*) which started increasing and reached maximum at 3rd larval instar (0.94) at *A. gossypii*. Similarly, as shown in Tables 1 to 4, the maximum S_x during the pupal stage was recorded in case of rearing on *A. gossypii* (0.889) while the and minimum value (0.836) was recorded at *T. tabaci*.

Mortality Survivor Ratio (MSR):

On the contrary of survival fraction, the value of increasing in the population that would have occurred if the mortality in the stage had not occurred (mortality survivor ratio) at egg stage was found maximum (0.361) in case of *T. tabaci* and minimum (0.163) at *A. gossypii*. Among larval instars, the predator *C. undecimpunctata* registered highest value of MSR (0.361) at the 1st instar in the case of feeding on *T. tabaci* and the lowest value (0.062) in case of *A. gossypii* during the 3rd larval instar. Similarly, the pupal stage attained minimum MSR (0.1238) at *A. gossypii* and maximum (0.1956) at *T. tabaci* (Tables 1-4).

Expectation of Life (E_x):

As illustrated in the Tables 1 to 4, the expectation of life (E_x) of *C. undecimpunctata* at the egg stage recorded minimum (3.015) at *T. tabaci* and maximum (4.565) at *A. gossypii*. While comparing the E_x between *C. undecimpunctata* larval instars, it remained maximum (4.227) during 1st instar at *M. persicae*, whereas, the lowest value (2.05) was encountered at fourth instar at *T. tabaci*. Likewise, the E_x for pupae was recorded minimum (1.337) at *T. tabaci* and maximum (1.389) of the same stage was recorded at *A. gossypii*.

K-Values:

From one generation to the next the k-value has a vital role in determining the increase or decrease in number of insect individuals. The k-values were computed at egg stage of *C. undecimpunctata* and recorded the highest value (0.1337) in case of rearing the *C. undecimpunctata* on *T. tabaci* while the lowest value (0.065) was observed at *A. gossypii*. While in case of comparing larval instars, the k-values at 0.02613 and 0.1338 were recorded in the 3rd instars of *A. gossypii* and 1st instar of *T. tabaci* as maximum and minimum values, respectively. During the pupation period, the maximum k-value (0.0776) was observed in *T. tabaci*. The k-value of total generation of *C. undecimpunctata* mortality was recorded 0.6382, 0.4621, 0.3419 and 0.2798 at *T. tabaci*, *R. padi*, *M. persicae* and A. *gossypii*, respectively (Tables 1-4).

Table 1. Stage-specific life-table parameters of the eleven-spot ladybird, *Coccinella undecimpunctata* on *Rhopalosiphum padi* under laboratory conditions

X	I_X	d_x	L_x	T_x	E_x	% .A.M	% R.M	MSR	IM	S_x	Log I_x	K-value
Eggs	50	9.5	45.25	186	3.72	19	19	0.235	4.05	0.81	1.699	0.091515
1st Instar	40.5	7.5	36.75	140.75	3.475	18.52	15	0.227	3.92	0.815	1.607	0.088941
2nd Instar	33	5.75	30.125	104	3.15	17.42	11.5	0.211	3.64	0.826	1.519	0.083147
3rd Instar	27.25	4	25.25	73.875	2.71	14.68	8	0.172	2.97	0.85	1.435	0.068944
4th instar	23.25	3.5	21.5	48.625	2.091	15.05	7	0.177	3.06	0.849	1.367	0.070856
Pupae	19.75	2.5	18.5	27.125	1.37	12.66	5	0.145	2.5	0.87	1.296	0.058778
Adults	17.25	17.25	8.625	8.625	0.5	100	34.5				1.24	0.462181

Table 2. Stage-specific life-table parameters of the eleven-spot ladybird, *Coccinella undecimpunctata* on *Aphis gossypii* under laboratory conditions

X	I_X	d_x	L_x	T_x	E_x	% .A.M	% R.M	MSR	IM	S_x	Log I_x	K-value
Eggs	50	7	46.5	228.25	4.565	14	14	0.163	4.27	0.86	1.699	0.065502
1st Instar	43	5	40.5	181.75	4.227	11.628	10	0.1316	3.454	0.884	1.633	0.053685
2nd Instar	38	3.75	36.125	141.25	3.717	9.868	7.5	0.109	2.874	0.901	1.58	0.045123
3rd Instar	34.25	2	33.25	105.125	3.069	5.839	4	0.062	1.628	0.942	1.535	0.026131
4th instar	32.25	2.75	30.875	71.875	2.229	8.527	5.5	0.093	2.447	0.915	1.509	0.038708
Pupae	29.5	3.25	27.875	41	1.389	11.02	6.5	0.124	3.25	0.89	1.47	0.050693
Adults	26.25	26.25	13.125	13.125	0.5	100	52.5			0	1.419	0.279841

Table 3. Stage-specific life-table parameters of the eleven-spot ladybird, *Coccinella undecimpunctata* on *Myzus persicae* under laboratory conditions

X	I_X	d_x	L_x	T_x	E_x	% .A.M	% R.M	MSR	IM	S_x	Log I_x	K-value
Eggs	50	8.75	45.63	213.25	4.265	17.5	17.5	0.212	4.826	0.825	1.699	0.083546
1st Instar	41.25	5.5	38.5	167.625	4.064	13.33	11	0.154	3.5	0.867	1.615	0.062148
2nd Instar	35.75	3.75	33.88	129.125	3.612	10.489	7.5	0.117	2.666	0.895	1.55	0.048126
3rd Instar	32	2	31	95.25	2.977	6.25	4	0.067	1.5167	0.938	1.505	0.028029
4th instar	30	3.5	28.25	64.25	2.142	11.67	7	0.132	3.005	0.883	1.477	0.053875
Pupae	26.5	3.75	24.625	36	1.358	14.151	7.5	0.165	3.75	0.858	1.423	0.066264
Adults	22.75	22.75	11.375	11.375	0.5	100	45.5			0	1.357	0.341989

Table 4. Stage-specific life-table parameters of the eleven-spot ladybird, *Coccinella undecimpunctata* on *Thrips tabaci* under laboratory conditions

X	I_X	d_x	L_x	T_x	E_x	% .A.M	% R.M	MSR	IM	S_x	Log I_x	K-value
Eggs	50	13.25	43.375	150.75	3.015	26.5	26.5	0.361	4.146	0.735	1.699	0.133713
1st Instar	36.75	9.75	31.875	107.375	2.922	26.53	19.5	0.361	4.153	0.735	1.565	0.133894
2nd Instar	27	6.5	23.75	75.5	2.796	24.07	13	0.317	3.646	0.7593	1.4313	0.11961
3rd Instar	20.5	4.25	18.375	51.75	2.52	20.732	8.5	0.262	3.0077	0.793	1.3118	0.1009
4th instar	16.25	2.5	15	33.375	2.054	15.385	5	0.182	2.091	0.846	1.211	0.072551
Pupae	13.75	2.25	12.625	18.375	1.336	16.364	4.5	0.196	2.25	0.836	1.138	0.077605
Adults	11.5	11.5	5.75	5.75	0.5	100	23			0	1.061	0.638272

The Seven-Spot Ladybird, *Coccinella septempunctata:*

Apparent Mortality:

Results in Tables 5 to 8 indicated that at egg stage, the apparent mortality was observed maximum (18.5 %) at *T. tabaci* and minimum (6.5 %) at *A. gossypii*. When a comparison was made between larval instars, the highest mortality (25.81 %) was observed at *T. tabaci* at 2nd larval instar, whereas, minimum death (3.45 %) was recorded at 3rd instar at *A. gossypii*. Similarly, the apparent mortality at pupal stage remained maximum (12.61 %) at *R. padi*, and minimum (8.82 %) at *T. tabaci*.

Expectation of Life (Ex):

The data in Tables 5 to 8 clarify a continuous decline in the expectancy of life by the development of *C. septempunctata* from one stage to another. At egg stage, the expectation of life (E_x) or mean life was recorded a minimum value (3.43) at *T. tabaci* and maximum value (4.87) at *R. padi* (Table 5). The expectancy of life during the larval instars was remained maximum (4.223) during 1st instar of *C. septempunctata* at *M. persicae*, while the lowest value (2.17) was encountered at 4th instar of *C. septempunctata* at *M. persicae*. Likewise, the E_x for pupae of *C. septempunctata* was recorded maximum (1.411) at *T. tabaci* and minimum (1.373) of the same stage were recorded at *R. padi*.

Survival Rate (S_x):

At egg stage of *C. septempunctata*, the survival rates were noted maximum values 0.935 and 0.885 at *A. gossypii* and *M. persicae*, respectively (Tables 6&7). The minimum value of S_x (0.815) was observed in case of rearing on *T. tabaci* (Table 8). The 1st larval instar exhibited the highest S_x (0.893) at *M. persicae* (Table 7), whereas the lowest S_x (0.761) was recorded at *T. tabaci*. Among the 2nd instar the highest S_x (0.923) at *R. padi*, whereas the lowest rate (0.742) was recorded at *T. tabaci* (Table 8). Similarly, at 3rd instar, the S_x was found maximum (0.97) at *A. gossypii* and minimum (0.84) at *T. tabaci*. The highest survival rate in the 4th larval instar (0.925) was observed at *R. padi* (Table 5) while the lowest value (0.88) was observed at *M. persicae* (Table 7). In contrast, pupa stage attained a high rate of survival (0.912) at *T. tabaci* and low survival (0.873) at *R. padi* (Tables 5-8).

Mortality Survivor Ratio:

The mortality survivor ratio (MSR) during egg stage was found a minimum (0.0695) at *A. gossypii* (Table 6) and maximum (0.227) at *T. tabaci* (Table 8). Also, the predator *C. septempounctata* registered maximum value of MSR (0.348) during the 2nd instar in case of feeding on *T. tabaci* and lowest (0.0357) in case of *R. padi* during the 3rd larval instar. However, the pupal stage attained MSR minimum value (0.0967) at *T. tabaci* and maximum value (0.144) at *R. padi* (Table 5).

k-Values:

At egg stage, the k-value was found the maximum (0.088) at *T. tabaci* and minimum (0.029) at *A. gossypii*. While in case of comparing larval instars, the Tables from 5 to 8 revealed that the highest "k value" (0.1296) at 2nd instar at *T. tabaci* and lowest value (0.0152) recorded at 3rd instar at *A. gossypii*. At pupal stage, k-value was maximum (0.05855) at *R. padi* and minimum (0.0401) at *T. tabaci*. The total generation mortality 'K' was recorded maximum (0.50863) at *T. tabaci* (Table 8) and minimum (0.2403) at *A. gossypii*. (Table 6)

Table 5. Stage-specific life-table parameters of the eleven-spot ladybird, *Coccinella septempunctata* on *Rhopalosiphum padi* under laboratory conditions

X	I_X	d_x	L_x	T_x	E_x	% .A.M	% R.M	MSR	IM	S_x	Log I_x	K-value
Eggs	50	8.25	45.875	217	4.34	16.5	16.5	0.198	4.792	0.835	1.699	0.078
1st Instar	41.75	6.25	38.625	171.125	4.098	14.97	12.5	0.1761	4.269	0.85	1.621	0.07
2nd Instar	35.5	2.75	34.125	132.5	3.732	7.746	5.5	0.084	2.036	0.923	1.55	0.035
3rd Instar	32.75	2.75	31.375	98.375	3.004	8.397	5.5	0.092	2.223	0.916	1.515	0.0381
4th instar	30	2.25	28.875	67	2.233	7.5	4.5	0.081	1.966	0.925	1.477	0.034
Pupae	27.75	3.5	26	38.125	1.374	12.61	7	0.144	3.5	0.874	1.443	0.059
Adults	24.25	24.25	12.125	12.125	0.5	100	48.5	0.774	18.78667	5.323	1.385	0.314

Table 6. Stage-specific life-table parameters of the eleven-spot ladybird, *Coccinella septempunctata* on *Aphis gossypii* under laboratory conditions

X	I_X	d_x	L_x	T_x	E_x	% .A.M	% R.M	MSR	IM	S_x	Log I_x	K-value
Eggs	50	3.25	48.375	243.75	4.875	6.5	6.5	0.0695	1.999	0.935	1.699	0.029
1st Instar	46.75	6.75	43.375	195.375	4.179	14.44	13.5	0.169	4.852	0.856	1.6698	0.068
2nd Instar	40	3.75	38.125	152	3.8	9.375	7.5	0.103	2.974	0.906	1.6	0.043
3rd Instar	36.25	1.25	35.625	113.875	3.1414	3.4483	2.5	0.036	1.0268	0.966	1.559	0.015
4th instar	35	3	33.5	78.25	2.236	8.571	6	0.094	2.695	0.9143	1.544	0.0389
Pupae	32	3.25	30.375	44.75	1.398	10.156	6.5	0.113	3.25	0.898	1.51	0.047
Adults	28.75	28.75	14.375	14.375	0.5	100	57.5			0	1.459	0.2403

Table 7. Stage-specific life-table parameters of the eleven-spot ladybird, *Coccinella septempunctata* on *Myzus persicae* under laboratory conditions

X	I_X	d_x	L_x	T_x	E_x	% .A.M	% R.M	MSR	IM	S_x	Log I_x	K-value
Eggs	50	5.75	47.125	234	4.68	11.5	11.5	0.1299	3.444	0.885	1.699	0.0531
1st Instar	44.25	4.75	41.875	186.875	4.223	10.734	9.5	0.12	3.187	0.893	1.646	0.0493
2nd Instar	39.5	3.75	37.625	145	3.671	9.494	7.5	0.1049	2.78	0.905	1.597	0.0433
3rd Instar	35.75	2.25	34.625	107.375	3.003	6.294	4.5	0.0672	1.7799	0.937	1.553	0.028
4th instar	33.5	4	31.5	72.75	2.172	11.94	8	0.136	3.59	0.881	1.525	0.055
Pupae	29.5	3	28	41.25	1.398	10.17	6	0.1132	3	0.898	1.4698	0.0466
Adults	26.5	26.5	13.25	13.25	0.5	100	53			0	1.423	0.276

Table 8. Stage-specific life-table parameters of the eleven-spot ladybird, *Coccinella septempunctata* on *Thrips tabaci* under laboratory conditions

X	I_X	d_x	L_x	T_x	E_x	% .A.M	% R.M	MSR	IM	S_x	Log I_x	K-value
Eggs	50	9.25	45.375	171.5	3.43	18.5	18.5	0.227	3.518	0.815	1.699	0.0889
1st Instar	40.75	9.75	35.875	126.125	3.095	23.93	19.5	0.315	4.875	0.76	1.61	0.1188
2nd Instar	31	8	27	90.25	2.91	25.81	16	0.348	5.391	0.742	1.491	0.1296
3rd Instar	23	3.75	21.125	63.25	2.75	16.3	7.5	0.195	3.019	0.837	1.362	0.0773
4th instar	19.25	2.25	18.125	42.125	2.188	11.688	4.5	0.1324	2.051	0.88	1.284	0.054
Pupae	17	1.5	16.25	24	1.412	8.824	3	0.097	1.5	0.912	1.23	0.04
Adults	15.5	15.5	7.75	7.75	0.5	100	31			4.9495	1.19	0.509

Developmental Periods of the *C. undecimpunctata* and *C. septempunctata* on Four Different Host Species:

The incubation period of the egg stage of *C. undecimpunctata* was completed on 3.56±0.46, 4.66±0.66, 4.72±0.34 and 5.41±0.93 days when the predator reared on *A. gossypii, M. persicae, R. padi* and *T. tabaci*, respectively (Table 9). The highest duration period of the total larval development reached to 14.19±0.89 days when the predator feed on *T. tabaci* followed by *R. padi* (12.41±1.26 days), *M. persicae* (10.11±0.39 days) and finally *A. gossypii* (8.69±0.77). Durations of the pupa stage of *C. undecimpunctata* on the different preys varied from 3.31 days (on *A. gossypii*) to 5.34 days (on *T. tabaci*). On the other hand,

the longevity of *C. undecimpunctata* was completed in 76.19±4.16, 83.94±4.404, 88.88±2.74 and 91.19±3.27 when reared on *T. tabaci*, *M. persicae*, *R. padi* and *A. gossypii*, respectively.

Concerning *C. septemounctata*, the egg incubation periods recorded 3.53±0.425, 4.41±0.543, 4.81±0.47 and 6.44±0.83 days when reared on *A. gossypii*, *M. persicae*, *R. padi* and *T. tabaci*, respectively (Table 10). The highest duration period of the total larval development reached to 20.69±1.42 days when the predator feed on *T. tabaci* followed by *R. padi* (17.5±0.77 days) without significant differences than *M. persicae* (16.69±1.65 days) and finally the least total larval duration were recorded on *A. gossypii* (13.44±1.03). The data also revealed that the duration of the pupa stage of *C. septempunctata* varied significantly from one prey to the other on the different preys. The pupa stage durations recorded 4.19±0.389, 5.41±0.46, 6±0.48 and 6.22±0.48 days on *A. gossypii*, *M. persicae*, *R. padi* and *T. tabaci*, respectively. While the adult longevities of *C. septempunctata* can be arranged in descending order as follows, 83.88±3.3776.31±3.33, 72.88±2.99 and 62.88±2.99 when reared on *A. gossypii*, *M. persicae*, *R. padi* and *T. tabaci*, respectively.

Table (9): Developmental period of *Coccinella undecimpunctata* on four different hosts

Biological aspects	*A. gossypii*	*M. persicae*	*R. padi*	*T. tabaci*	F value	L.S.D.
incubation period	3.56±0.46^{b}	4.66±0.664^{b}	4.72±0.34^{b}	5.41±0.93^{a}	5.698	0.98395
1st larval instar	1.78±0.16^{c}	2.16±0.41^{bc}	2.22±0.27^{ab}	2.69±0.36^{a}	5.498	0.48865
2nd larval instar	1.97±0.258^{c}	2.33±0.281^{c}	3.22±0.4^{b}	4.16±0.258^{a}	41.27	0.46795
3rd larval instar	2.09±0.188^{c}	2.56±0.33^{bc}	2.94±0.48^{ab}	3.22±0.37^{a}	7.327	0.55455
4th larval instar	2.84±0.52^{b}	3.06±0.315^{b}	4.03±0.483^{a}	4.13±0.62^{a}	6.955	0.76735
Total larval durations	8.69±0.77^{d}	10.11±0.39^{c}	12.41±1.26^{b}	14.19±0.89^{a}	30.052	1.36925
Pupal stage	3.31±0.33^{b}	3.56±0.43^{b}	4.69±0.46^{a}	5.34±1.1^{a}	8.5	1.0095
Adult Longevity	91.19±3.27^{a}	83.94±4.404^{b}	88.88±2.74^{ab}	76.19±4.16^{c}	12.841	5.70561

Table (10): Developmental period of *Coccinella septempunctata* on four different hosts

Biological aspects	*A. gossypii*	*M. persicae*	*R. padi*	*T. tabaci*	F value	L.S.D.
incubation period	3.53±0.425^{c}	4.41±0.543^{c}	4.81±0.47^{b}	6.44±0.83^{a}	17.149	1.04495
1st larval instar	2.31±0.415^{b}	2.91±0.45^{b}	2.88±0.27^{b}	3.97±0.47^{a}	11.432	0.63015
2nd larval instar	2.78±0.472^{c}	3.1562±0.57^{bc}	3.56±0.53^{b}	4.66±0.39^{a}	10.770	0.7607
3rd larval instar	3.94±0.725^{a}	4.53±0.57^{a}	4.69±0.53^{a}	5.03±1.03^{a}	1.521	1.141
4th larval instar	4.41±0.41^{c}	6.09±0.78^{b}	6.38±0.88a^{b}	7.03±0.53^{a}	10.781	1.0493
Total larval durations	13.44±1.03^{c}	16.69±1.65^{b}	17.5±0.77^{b}	20.69±1.42^{a}	22.137	1.9505
Pupal stage	4.19±0.389^{c}	5.41±0.461^{b}	6±0.48^{ab}	6.22±0.48^{a}	16.082	0.6999
Adult Longevity	83.88±3.37^{a}	76.31±3.33^{b}	72.88±2.99^{b}	62.88±2.99^{c}	30.17	4.8894

DISCUSSION

The two-coccinellid predators, *C. septempunctata* and *C. undecimpunctata* were able to develop and reach the adult stage when fed on each of the four preys (*M. persicae*, *A. gossypii*, *R. padi* and *T. tabaci*). Sunil *et al*., 1999 studied the biotic potential of three coccinellid predators (*C. septempunctata*, *C. transversalis* and *Cheilomenes sexmaculata*) on six different aphid hosts (*Aphids craccivora*, *A. gossypii*, *A. nerii*, *Lipaphis erysimi*, *Rhopalosiphum maidis* and *Uroleucon compositae*) and found that these three predators accept all the six hosts. Also, Solangi *et al*. (2009) studied the life table of *C. septempunctata* on different hosts (*Schizaphis graminum*, *Lipaphis erysimi*, *Aphis nerii*, *Rhopalosiphum maidis*, *Therioaphis trifolii*) and the coccinellid predator reached the adult stage when fed on each of the five preys.

The high rates of mortality of *C. undecimpunctata* and *C. septempunctata* stages were observed more in case of rearing on *T. tabaci* and *R. padi*, while the lowest rates of mortalities were obtained at *A. gossypii*. This is probably because *A. gossypii* as a host was preferable by the developmental stages of the two predators than the other preys. On the other hand, in agreement with Ali and Rizvi, 2009a and Ali and Rizvi, 2009b the early larval instars, showed higher mortality at first as well as second instar than the 3rd and 4th instars and this is probably because their much delicate of the 1st instar than the later instars. While Kindlmann, *et al*. (2000) found that the larvae of two predatory ladybird species, *Harmonia axyridis* and *C. septempunctata* were suffered the greatest mortality during the first and fourth instars. On all the different hosts, the life expectancy (ex) of *C. undecimpunctata* and *C. septempunctata* showed steadily declined throughout the whole generation while at an early stage of development the life expectancy (ex) showed an discontinuous decline. These findings (the trends of life expectancy of the two predators) are in agreement with Kontodimas, 2008; Ali, and Rizvi, 2009a and Ali, and Rizvi, 2009b.

The survival fractions of the developmental stages of the two predators showed a reverse pattern as of apparent mortality whereas its maximum values were recorded at *A. gossypii* as compared to other hosts. Also, the later stages were high in their survival fraction than the earlier stages and/or instars.

The apparent mortality, indispensable mortality and mortality survivor ratio in the different developmental stage of *C. septempunctata* were substantially lower than for *C. undecimpunctata* while the survival fractions of these developmental stages were lower for *C. undecimpunctata* than for *C. septempunctata*. This is probably because the larvae of *C. septempunctata* are more voracious than *C. undecimpunctata* for the different preys.

The data on life table parameters indicated that among four different hosts the total generation mortalities "K values" of *C. undecimpunctata* and *C. septempunctata* were recorded maximum values at *T. tabaci*. While lower values of the total generation mortalities were recorded at *A. gossypii*. Therefore the cotton aphid, *A. gossypii* has been proved as a most preferable and suitable prey for the development of *C. septempunctata* and *C. undecimpunctata*. Solangi, *et al*. (2009) studied the life table of *Coccinella septempunctata* on five different aphid species (*Schizaphis graminum*, *Lipaphis erysimi*, *Aphis nerii*, *Rhopalosiphum maidis*, *Therioaphis trifolii*). They found that the life table parameters of the *C. septempunctata* are shortest on *Therioaphis trifolii* (the most preferable) and longest on *A. nerii*. The different prey species lead to the differences in the complete life span of the two predators. The longest periods for the immature stages were obtained in case of *T. Tabaci* while the longest longevity periods were observed in case of *A. gossypii*. According to Ghanim *et al*., 2014 the total life cycle of *C. undecimpunctata*, which reared on *Sitobion avenae* varied than those, reared on *Schizaphis graminum*. Shukla and Jadhav (2014) reported that the total life cycle of *C. transversalis* when reared on *A. craccivora*, *L. erysimi* and *M. persicae* were different.

Conclusion

It may be concluded from the present findings that the two predators, *C. septempunctata* and *C. undecimpunctata* are among the most important natural enemies of three aphid species; *M. persicae*, *A. gossypii* and *R. padi* and onion thrips, *T. tabaci*. Studying of life table parameters of the two predators indicated that the cotton aphids, *A. gossypii* has been proved as a most preferable and suitable prey for the development of *C. septempunctata* and *C. undecimpunctata*. Also, the data obtained in this study can provide insight into the demographics of coccinellid populations. The different prey species lead to the differences in the whole life span of the two predators and longest periods for the immature stages were obtained in case of *T. Tabaci* while the longest longevity periods were observed in case of *A. gossypii*.

REFERENCES

Afrane Y. A.; Zhou G.; Lawson B. W.; Githeko A. K. and Yan G. (2007) Life table analysis of *Anopheles arabiensis* in Western Kenya Highlands: Effects of land covers on larval and adult survivorship. American Journal of Tropical Medicine and Hygiene. 77(4): 660–666.

Ali, A. and Rizvi, P.Q. (2009a) Life table studies of *Menochilus sexmaculatus* Fabr. (Coleoptera Coccinellidae) at varying temperature on *Lipaphis erysimi* Kalt. World Applied Science Journal. 7: 897-901.

Ali, A. and Rizvi, P.Q. (2009b) Age and Stage Specific Life-Table of *Coccinella transversalis*.with Regards to Various Temperatures. Tunisian Journal of Plant Protection. 4(2): 211-220

Ali, A. and Rizvi, P.Q. (2007a) Development and predatory performance of *Coccinella septempunctata* L. (Coleoptera: Coccinellidae) on different aphid species. Journal of Biological Sciences. 7: 1478-1483.

Ali, A., Rizvi P.Q. and Pathak, M. (2009) Reproductive performance of *Coccinella transversalis* Fabricius (Coleoptera: Coccinellidae) on different aphid species. Biosystematica, 3: 37-41.

Arshad Ali (2008) Studies on population dynamics of some coccinellid and syrphid species. Ph. D. Thesis, Faculty of Agriculture Sciences, Aligarh Muslim Univ., India, 289 pp.

Bellows T.S. and Van Driesche, R.G. (1999) Life Table Construction and Analysis for Evaluating Biological Control Agents. Hand book of Biological Control. https://www.sciencedirect.com/book/9780122573057/handbook-of-biological-control

Birch L C., (1948) The Intrinsic rate of natural increase of an insect population. Journal of Animal Ecology 17:15–26.

Ghanim, A. A.; Abd Allah F. E. and Abd El-Aziz, A. A. (2014) Influence of nutrition's on longevity and fecundity the coccinellid predators, Coccinella *undecimpunctata* L. (Coleoptera: Coccinellidae). J. Plant Prot. and Path., Mansoura Univ., Vol.5 (7): 827-835, 2014.

Chi H. and Yang, T. C., (2003) Two-sex life table and predation rate of *Propylaea japonica* Thunberg (Coleoptera: Coccinellidae) fed on *Myzus persicae* (Sulzer) (Homoptera: Aphididae). Environmental Entomology, vol. 32, pp. 327–333.

Jamie C. Abrams, (1990) Biological Control Agents in Integrated Pest Management: Are They Regulated – A Research Guide, 8 Pace Environmental Law Review. 89 http://digitalcommons.pace.edu/pelr/vol8/iss1/5

Imam, I. I., (2015) Biological characteristic of eleven-spot ladybird Coccinella undecimpunctata (Linnaeus), reared on cowpea aphid, *Aphis craccivora* (Kock), under laboratory conditions. Mansoura Journal of Plant Protection and Pathology, Mansoura Univ., Vol. 6 (6): 909 – 914

Kakde, A. M., Patel K.G. and Shailesh Tayade (2014) Role of Life Table in Insect Pest Management--A Review. Journal of Agriculture and Veterinary Science. 7(1): 40-43.

Kindlmann P.; Yasuda H.; Sato S. and Shinya, K. (2000) Key life stages of two predatory ladybird species (Coleóptera: Coccinellidae). European Journal of Entomology. 97: 495-499.

Kontodimas D.C.; Milonas P.G.; Stathas G.J.,; Papanikolaous N. E.; Anna Skourti and Matsinos Y. G., (2008) Life table parameters of the aphid predators *Coccinella septempunctata, Ceratomegilla undecimnotata* and *Propylea quatuordecimpunctata* (Coleoptera: Coccinellidae). European Journal of Entomology. 105(3): 427-430

Kundoo A. A. and Khan, A. A. (2017) Coccinellids as biological control agents of soft bodied insects: A review. Journal of Entomology and Zoology Studies; 5(5): 1362-1373

Mahyoub, Jazem A.; Ashraf A. H. Mangoud; Khaled M. AL-Ghamdi and Hamed A.Al-Ghramh, (2013) Method For Mass Production the Seven Spotted Lady Beetle, *Coccinella Septempunctata* (Coleoptera: Coccinellidae) and Suitable Manupulation of Egg Picking Technique. Egypt. Acad. J. Biolog. Sci., 6(3): 31 -38.

Sahito H. A.; Kousar; W. Muhammad; Mangrio; N. A. Mallah; F. A. Jatoi; Z. H. Shah and W. A. Kubar, (2017) Stage Specific Life Table of Invasive Pest Mealybug, Phenacoccus Solenopsis (Tinsley) Under Cotton Field Conditions. Current Research in Agricultural Sciences. (4) 2: 43-50.

Solangi, B. K.; Hong L. W.; Haider S. A. and Mastoi, M. l. (2009) Life Table of *Coccinella septempunctata* Linn. on Different Host Species in Laboratory. Life Sci. Int. J. 3(3): 1223-1230

Shukla, A. and D. Jadhav (2014) Biology of *Coccinella transversalis* (Fabricius) on different aphid species. An international Quarterly Journal of Life Science (The Bioscan) 9(1): 17-22.

Southwood, T. R. E. (1978) Ecological methods with particular reference to study of insect population. The English Language Book Society and Chapman and Hall, London, 524 pp.

Sunil-Joshi; Ballal, C. R.; Rao N. S.; Joshi, S. (1999) Biotic potential of three coccinellid predators on six different aphid hosts. Journal of entomological research. 23(1):1-7

ARABIC SUMMARY

جداول الحياة العمرية لحشرات أبوالعيد ذو السبع نقاط *Coccinella septempunctata* وأبوالعيد ذو الإحدي عشر نقطة *Coccinella undecimpunctata* علي عوائل مختلفة تحت الظروف المعملية

عدنان عبدالفتاح السيد درويش
قسم وقاية النبات- كلية الزراعة جامعة دمنهور

تعتبر يرقات وخنافس حشرات أبو العيد من أهم المفترسات الحشرية للكثير من الآفات علي معظم المحاصيل. هذه الحشرات لها قوة افتراسية عالية خاصة علي حشرات المنّ والحشرات القشرية والبق الدقيقي والذباب الابيض ونطاطات الاوراق والتربس. هذا وتستخدم دراسات جداول الحياه لوصف معدلات الوفيات ومعدلات البقاء وتوقعات الافراد الحية عند عمر معين للكائنات الحية (الحشرات) في الأجيال المتتابعة. وقد استهدف هذا البحث دراسة مقارنة جداول الحياة العمرية Stage-specific life-table لكل من المفترسين الحشريين أبو العيد ذو السبع نقاط *C. septempunctata* وأبو العيد ذو الإحدي عشر نقطة *C. undecimpunctata* وذلك علي أربعة عوائل مختلفة هي حشرات منً الخوخ الأخضر *Myzus persicae*، منً القطن *Aphis gossypii*، منً الشوفان *Rhopalosiphum padi* وتربس القطن *Thrips tabaci* وذلك تحت الظروف المعملية. أظهرت الدراسة أن معدلات الموت الظاهري ومعدلات الموت الحقيقي ومعدلات الموت الكلي كانت أعلي في حالة تربية المفرسيين علي حشرة تربس القطن مقارنة بتلك المفترسات التي تم تربيتها علي حشرات منً الشوفان ثم منً الخوخ الأخضر وأخيرا منً القطن، علي الترتيب. من ناحية أخري فإن معدلات البقاء لأطوار النمو المختلفة كانت أعلي في حالة تربية هاتين المفترسيين الحشريين علي حشرة منً القطن مقارنة بالعوائل الأخري. كذلك أوضحت النتائج أن معدلات موت اليرقات كانت أعلي في العمر اليرقي الأول مقارنة بباقي الأعمار اليرقية وذلك في حالة التربية علي العوائل الأربعة المختلفة. وسجلت أقل فترة للنمو للمجموع الكلي للأعمار اليرقية لكلا المفترسيين الحشريين في حالة التربية علي حشرة منً القطن ويليها حشرة منً الخوخ الأخضر ثم منً الشوفان وأخيرا تربس القطن. وعلي ذلك ومن بيانات دراسة جداول الحياه فإنه من بين الأربعة عوائل المختلفة لهذه المفترسات فإن حشرة منً القطن وحشرة منً الخوخ الأخضر هي العوائل المناسبة والمفضلة لأطوار النمو المختلفة للمفترسين الحشريين أبو العيد ذو السبع نقاط وأبو العيد ذو الإحدي عشر نقطة.