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LIFE TABLE *S*TUDY OF THE COTTON LEAFWORM, *Spodoptera littoralis* (Boisd.) (Lepidoptera: Noctuidae) ON FIVE HOST PLANTS

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ABSTRACT

The cotton leafworm, *Spodoptera littoralis* (Boisd.) is an important pest on cotton and feeds on other host plants. In this study, development rate, age-specific survival and age-specific fecundity of cotton leafworm larvae reared on five host plants, (cotton, tomato, cabbage, zorbeyhh and mulberry) under laboratory conditions were studied for two successive generations. Results revealed that the cotton leafworm larvae survived on four host plants, but young larvae failed to survive on the fifth host (Mulberry). Thus, in both generations, the four host plants could be arranged according to their suitability for insect development in the following descending order cotton, tomato, cabbage and zorbeyhh. The least percentages of natural mortality were 9.02, 8.0, 7.44 and 1.02% when larvae were fed on cotton leaves for AM, RM, IM and MSR% mortality, respectively. Meanwhile, the highest mortality rates were 77.46, 32.30, 25.84 and 18.56% for AM, RM, IM and MSR% mortality, respectively, when larvae were fed on zorbeyhh leaves. At the same time, cotton leaves harbored the highest net reproductive rate (Ro) 593.38 females/female, while, the shortest reproductive rate was 21.8 females/female obtained when larvae were fed on zorbeyhh leaves. Also, the longest mean generation duration (Gt) was 39.99 days when larvae were fed on zorbeyhh leaves, while, the moderate duration was 32.10 days on cotton. The population intrinsic rate (rm) decreases from 0.1989, 0.1336, 0.1174 to 0.0783 individuals/female/day and the finites rate of increase (λ) were 1.220, 1.135, 1.25, and 1.085 individuals /female/ day on cotton, tomato leaves, cabbage leaves and zorbeyehh leaves, respectively. The highest intrinsic and finite rates of increase of *S. littoralis* were obtained when larvae were fed on cotton leaves. The population of cotton leafworm moth doubled once every 4.37, 6.87, 8.04 and 11.62 days when larvae were fed on the leaves of cotton, tomato, cabbage and zorbeyehh, respectively.

***Key words**: cotton leafworm (Spodoptera littoralis (Boisd.)), host plants, life table.*

1. INTRODUCTION

The cotton leafworm, *Spodoptera littoralis* (Boisd.) (Lepidoptera: Noctuidae) is one of the most destructive agricultural lepidopterous pests within its subtropical and tropical range. Also, it is a key pest for wide range of economical pests on cotton. The effect of larval diet on the biology of this pest was studied by many authors (Basu, 1943; Nasr and Ibrahim, 1965; Badr, 1967 and Patel *et al.,* 1968). Also, Moussa, *et al.,* (1960) mentioned that there is approximately 112 hosts of the cotton leafworm, in tropical and temperate zones of the old world. These plants include 73 species recorded in Egypt. Consequently, several authors namely (Badr, 1982; Rizk *et al.,* 1988; Mohamed, 2003; and Adham, *et al.,* 2009) contributed to the biology of *S. littoralis* and the effect of different host plants on its development and reproductive capacity. That may cause considerable damage by feeding on the leaves of field crops cotton and vegetables., fruiting points, flower buds and occasionally, also, on bolls (Salama *et al.,* 1971). In vegetables *e.g.* tomatoes, larvae bore into fruit which is, thus, rendered unsuitable for consumption. Numerous other crops are attacked, mainly on their leaves (Salama *et al.,* 1971). As in the other polyphagous moths, the availability of different host plants plays an important role in population increase and spread (Hunter and McNeil 1997). Different host plants are known to affect insect development, survival, reproduction and life table parameters. (Richard 1961; Varley and Gradwell 1970; Greenberg *et al*., 2001; Hansen *et al.,* 2004 and Liu *et al.,* 2004).

However, there is no information about life table parameters for *S. littoralis* on all host plants. Thus, demographic data could help assess the potential of population increase on cotton plants as well as on other host plants found around cotton area. Furthermore, tables could help explain why *S. littoralis* outbreaks occur in cotton area in Egyptian Governorates. Therefore, the objective of this study was to determine the effect of five host plants such as tomato, zorbeyhh, cabbage, cotton and mulberry on the development, survival, reproduction and life table parameters (the net reproductive rate (Ro), generation time (days) Tc or Gt, intrinsic rate of increase (rm), finite rate of increase (λ) and population doubling time (Dt) on each host and mortality distribution of the cotton leafworm, *S. littoralis* in the laboratory.

2.MATERIALS AND METHODS

2.1. Host plants

Five host plants were used in this investigation namely:

1.Cotton, *Gossypium barbadense* L. Fam. Malvaceae.
2.Tomato *Lycopersicum esculeatum* Fam. Solanaceae.
3.Cabbage, *Brassica oleracea* V. capitatu Fam. Cruciferae.
4.Zorbeyhh *Chenopodium album* Fam. Chenopodiaceae.
5. Mulberry, *Morus* sp. Fam. Moraceae.

The five host plants belonging to five different families are reported as hosts of the cotton leafworm, *S. littoralis*.

The first three plants were cultivated in the field, but the other two hosts (zorbeyhh and mulberry) were collected from neighboring trees of mulberry and berseem field, to provide satisfactory amounts of fresh leaves daily. Routine agricultural practices were followed for the cultivated three host plants and no insecticidal treatments were applied.

2.2.Test insect

Cotton leafworm larvae were obtained from batches of eggs collected from neighboring field. Larvae were reared for one generation on the same host plant on which the following generation was evaluated. Larvae from the next generation were used for tests. A mean rear temperature of 27 ± 2 °C and average relative humidity of 65 ± 5 % were recorded during the course of the present study.

2.3. Feeding tests

Groups of one hundred newly hatched larvae were fed each on one of the five host plant leaves. Each group was replicated 10 times, *i.e*. a total of 1000 larvae per host were tested. The larvae were kept in glass jars (250 cc) each covered with muslin. The number of larvae in each jar was reduced to 20 as larvae grew in size. Fresh host plant leaves were offered daily and larvae were checked every day to determine their duration and the mortality rates among the different instars in each case. The process was contained every day for each replicate until feeding ceased in pre-pupa. The resulting pupae were kept each in a separate vial till the moths emerged. Pairs of newly emerged adults were kept in glass jars and were offered sugar solution at the concentration of 10 % as food. Each jar was supplied with a small branch of *Nerium oleander* to act as a suitable site for oviposition. The deposited egg masses were collected and the number of eggs laid per female was counted. The procedures were repeated for two successive generations.

Data analysis: data were subjected to statistical analysis using complete randomized design (Gomize and Gomize 1984) moreover significant differences between the average of treatment were calculated according to Duncan (1955).

2.4. Functions life table parameters

Tables for age-specific survival (lx), and number of dying (dx) during the age interval were established according to the method described by Birch (1948) and by Anderwartha and Birch (1954). In this method the life table parameters were constructed and including:

1- Insect's population density in the development stages.
2- Age specific and survival rated or life table function (Lx).
3- Age specific fecundity (Mx) within a generation.

The following equations were used to establish:

* Apparent mortality percentage :

$$AM\,\% = \frac{dx_1}{lx_1} x100, \frac{dx_2}{lx_1} x100.....$$

* Real mortality :

$$RM\,\% = \frac{dx_1}{lx_1} x100, \frac{dx_2}{lx_2} x100.....$$

Also, these values were estimated:

- Indispensable mortality (IM %)
- Mortality – survivor ratio (MSR %) was estimated.

Definition and formulas for life table parameters.

Symbol	Definition	Formula
x	Age	..
Lx	Probability of an individual surviving to age x	..
Mx	Reproductive expectation of female at age x	..
Ro	Net reproductive rate, number of daughters that replace an average female in course of a generation	Ro= ∑Lx Mx
Tc (Gt)	Mean length of generation the approximated value of generation time.	$Tc=\frac{\sum XLXMX}{Ro}$
rm	Intrinsic rate of increase Total number of individual survived and mean number of female offspring birth was recorded at each age interval.	$rm=\frac{\text{Log } e^{Ro}}{Tc}$
λ	The finite rate of increase in number. The number of female per female per day *i.e.*	$\lambda = \text{Antilog } e^{rm}$
Dt	Doubling time	$Dt=\frac{(Log\ e^2)}{rm}$

3. RESULTS AND DISCUSSION

3.1. Biological aspects

Data in Table (1) show that the shortest mean incubation periods recorded for eggs of both generations were 3.5 ± 0.12, 3.4 ± 0.09 days on cotton, respectively. However, the highest means were (5.8 ± 0.05, 5.85 ± 0.12) and (5.28 ± 0.19, 5.4 ± 0.15) days on zorbeyhh and cabbage, in both seasons respectively.

The duration of larval stages of the cotton leafworm, *S. littoralis* was greatly affected by the different host plants. When larvae fed on zorbeyhh and cabbage leaves the highest larval mean durations were recorded (20.91 ± 0.08, 20.73 ± 0.15 days respectively). Moderate durations were recorded on the other host plants, e.g. Tomato (17.3 ± 0.12 days), cotton (17.56 ± 0.16 days) in the 1st generation. The same trend was observed in the 2nd generation. Moussa *et al.* (1960) and El.Saadany *et al.*(1994) reported that some hosts such as cotton tended to moderate duration of the larval stage.

Data also, show the effect of larval diet on the duration of the pupal stage, when larvae fed on tomato and cabbage leaves giving the highest pupal mean durations (10.86 ± 0.08, 9.39 ± 0.15 days, respectively). Moderate durations were recorded on cotton and zorbeyhh (7.87 ± 0.07, 8.08 ± 0.08 days, respectively) in the 1st generation. The same trend was recorded in the 2nd generation. Badr (1967) stated that the larval diet had some influence on the pupal period. Also, the mentioned findings are in agreement with those cited by Salama *et al.* (1971), Nasr *et al.* (1973) and El-Saadany *et al.* (1994).

Data in Table (2), also indicated that larvae fed on cotton leaves gave the highest percentage of pupation (92.5% & 95%) among the two generations, respectively. The contrary was obtained when larvae were fed on zorbeyhh (22.5% & 27.5%) respectively.

Also, the present data indicated that larvae fed on tomato and cotton leaves gave the highest percentages of adult emergence, while, when larvae were fed on zorbeyhh leaves they gave the shortest percentage of adult emergence in both generations.

In both generations, the sex ratio did not differ from 1:1 ratio. Data also, showed that larvae fed on cotton leaves gave the highest fecundity and egg hatchability. The contrary was obtained with zorbeyhh and cabbage.

Thus, cotton leaves proved to be the most suitable host plant for larval growth and development. On the other hand, zorbeyhh was the least suitable for *S. littoralis*. Also, in this study, cotton leaves proved to be the most favorable host plant for egg production. Moths originating from larvae fed on this host plant laid the highest number of eggs (1610.8 ± 45.5) and (1590.1 ±50.5) in both generations, respectively. However the results obtained by Badr (1967) revealed that females fed as larvae on tomato produced the highest number of eggs.

Table (1): Biological effects of different host plants on the cotton leafworm, *S.littoralis* for two generations, under laboratory conditions.

Stages	Host plants 1st generation Mean duration ± SE				Host plants 2nd generation Mean duration ± SE				In both generations
	Cotton	Tomato	Cabbage	Zorbeyhh	Cotton	Tomato	Cabbage	Zorbeyhh	Mulberry
Incubation Period	3.50± 0.12 a	4.7± 0.09 b	5.28± 0.19 c	5.8± 0.05 d	3.4± 0.09 a	4. 45± 0.16 b	5.4± 0.15 c	5.85± 0.12 d	6.30± 0.19
larval instars 1st instar	2.01± 0.11 a	2.01± 0.07 a	2.45± 0.03 a	2.0± 0.15 b	2.3± 0.17 a	2.01± 0.11 a	2.37± 0.16 b	2.17± 0.17 b	1.5± 0.15
2nd instar	2.10± 0.13 a	2.17± 0.05 a	2.45± 0.02 b	2.4± 0.11 b	2.17± 0.12 a	2.21± 0.16 a	2.43± 0.09 b	2.37± 0.12 b	Young larvae failed to survive in both generations
3rd instar	2.37± 0.11 a	2.27± 0.06 a	2.96± 0.02 b	3.0± 0.14 b	2.33± 0.17 a	2.37± 0.25 a	2.92± 0.16 b	3.13± 0.10 b	
4th instar	2.91± .013 b	2.65± 0.04 a	3.75± 0.02 c	3.87± 0.25 c	2.97± 0.29 a	2.76± 0.17 a	3.67± 0.24 b	3.91± 0.25 b	
5th instar	3.60± 0.12 a	3.17± 0.11 b	4.35± 0.03 c	4.46± 0.13 c	3.67± .17 b	3.21± 0.19 a	4.33± 0.12 c	4.57± 0.21 d	
6th instar	3.57± 0.16 a	5.03± 0.12 c	4.77± 0.03 b	5.18± 0.21 c	4.32± 0.16 a	5.1± 0.15 b	5.56± 0.14 c	5.46± 0.22 c	
Larval duration	17.56± 0.16b	17.3± 0.12 a	20.73± 0.15 c	20.91± 0.08 c	17.49± 0.07a	17.6± 60.13a	21.28± 0.16 b	21.61± 0.11c	
Pupal duration	7.87± 0.07 a	10.86± 0.08 d	9.39± 0.15 c	8.08± 0.08 b	7.64± 0.16 a	10.79± 0.07d	9.47± 0.15 c	8.18± 0.07 b	
Pupation %	92.5± 4.15 c	42.5± 2.17 b	40.0± 3.54 b	22.5± 2.17 a	95.0± 2.5 d	47.5± 0.17 c	35.0± 2.5 b	27.5± 4.15 a	
Adult emergence %	97.5± 2.17 c	100.0± 0.0 c	88.75± 5.7 b	79.17± 10.83a	94.72± 2.65 ab	88.75± 5.7 a	87.5± 6.25 a	85.42± 7.44 a	
sex ratio									
Male	38.11± 0.02	46.11± 0.23	42.44± 0.38	41.79± 0.01	37.68± 0.1	45.84± 0.18	44.58± 0.5	44.06± 0.27	
Female	37.29± 0.22	45.26± 0.28	41.97± 0.27	43.23± 0.13	36.85± 0.19	45.29± 0.12	42.75± 0.48	43.09± 0.3	
No.of eggs /female	1610.8± 45.5d	1327.6± 44.4c	927.6± 14.12 b	733.3± 26.3a	1590.1± 50.5d	1272.0± 38.0c	915.2± 15.1b	766.9± 45.1a	
Hatchability %	88.7± 0.27 d	63.1± 0.07 c	40.1± .37 a	41.7± 0.17 b	89.2± 0.16 d	68.3± 0.05 c	39.7± 0.29 a	45.3± 0.13 b	

Means followed by the same letters (difference between hosts in each generation) are not significantly different.

Finally, in both generations, young larvae failed to survive when larvae were fed on mulberry leaves.

Types of natural mortality, namely apparent mortality (AM), real mortality (RM), indispensable mortality (IM), and mortality – survivor ratio (MSR) factors were accordingly studied and the obtained results are presented in Tables (2. 3, 4, and 5).

3.2.1 Apparent mortality (AM)

At egg stage, the apparent mortality reached the maximum (59.9 and 58.3%) on cabbage and zorbeyehh, respectively, and the minimum (11.3 %) on cotton in the 1st generation. The same trend was recorded in the 2nd generation, where the maximum (AM) values were (60.3 and 54.7%) in the case of cabbage and zorbeyhh, respectively, while the minimum (AM) value was (10.8 %) on cotton.

The larvae showed the maximal percentage of (AM) (77.46 %) on zorbeyhh, whereas, the minimum death (9.02 %) was recorded on cotton. Also, pupal stage showed the highest mortality (20.28 %) on zorbeyhh, while the minimum death (6.94 %) was recorded on cotton in the 1st generation. The same trend was recorded for larval and pupal stages in the 2nd generation.

Table (2): The change in the number of survival and mortality types in each age class of *S. littoralis*, when larvae were fed on cotton leaves during the 1st and 2nd generations.

Measured age class	1st generation			
	Stages			
	Eggs	Larvae	Pupae	Adults
1x	1000	887	807	751
Dx	113	80	56	
Apparent mortality (AM %)	11.3	9.02	6.94	
Real mortality (RM %)	11.3	8.0	5.6	
Indispensable mortality (IM %)	9.57	7.44	5.6	
Ratio (MSR) %	1.13	1.02	0.86	
	2nd generation			
1x	1000	892	803	755
dx	108	89	48	
AM %	10.8	9.98	5.98	
RM %	10.8	8.9	4.8	
IM %	9.14	8.37	4.8	
MSR %	1.08	1.12	0.74	

Table (3): The change in the number of survival and mortality types in each age class of *S. littoralis*, when larvae were fed on tomato leaves during the 1st and 2nd generations.

Measured age class	1st generation			
	Stages			
	Eggs	Larvae	Pupae	Adults
1x	1000	631	268	239
Dx	369	363	29	
AM %	36.9	57.33	10.82	
RM %	36.9	36.3	2.9	
IM %	27.41	32.37	2.9	
MSR %	3.7	9.12	4.04	
	2nd generation			
1x	1000	683	324	288
Dx	317	359	36	
AM %	31.7	52.56	11.11	
RM %	31.7	35.9	3.6	
IM %	17.92	31.91	3.6	
MSR %	3.17	7.7	3.43	

3.2.2. Real mortality (RM)

For the larval stage, the maximum real mortality (36.3%) was obtained on tomato, while the minimum (8.0%) on cotton. However, for pupal stage the maximum real mortality (5.6 %) was recorded on cotton, while, the minimum (1.8 %) on cabbage during the 1st generation. The same trend was obtained for larval and pupal stages in the 2nd generation.

3.2.3. Indispensable mortality (IM)

Indispensable mortality (IM) at egg stage was the maximum (9.57 and 9.14 %) on cotton in the two generations, respectively. On the other hand, indispensable mortality was high in the larval stage on all the tested host plants in both generations. Likewise, the IM for pupae was the maximum (5.6 and 4.8 %) on cotton, whereas, the minimum IM (1.8 and 1.7 %) was recorded on cabbage in both generations, respectively.

3.2.4. Mortality survivor Ratio (MSR)

Mortality survival ratio, at egg stage was the maximum (6.0) on cabbage. At the larval stage, the maximum (18.56%) was recorded on zorbeyhh. On the other hand, the minimum ratio of egg stage (1.13%) was obtained on cotton. For larval stage, the minimum (1.02%) was recorded on cotton. Furthermore, for pupal stages, the highest MSR (22.63%) was observed on zorbeyhh, and the lowest (0.86%) on cotton in the 1st generation (Tables 2, 3, 4, and 5).

Table (4): The change in the number of survival and mortality types in each age class of *S. littoralis*, when larvae were fed on cabbage leaves during the 1st and 2nd generations.

Measured age class	1st generation			
	Stages			
	Eggs	Larvae	Pupae	Adults
1x	1000	401	160	142
Dx	599	241	18	
AM %	59.9	60.1	11.25	
RM %	59.9	24.1	1.8	
IM %	39.14	21.39	1.8	
MSR %	6.0	15.0	7.0	
	2nd generation			
1x	1000	397	139	122
dx	603	258	17	
AM %	60.3	64.99	12.23	
RM %	60.3	25.8	1.7	
IM %	19.0	22.64	1.7	
MSR %	6.0	16.0	9.0	

Table (5): The change in the number of survival and mortality types in each age class of *S. littoralis*, when larvae were fed on zorbeyhh leaves during the 1st and 2nd generations.

Measured age class	1st generation			
	Stages			
	Eggs	Larvae	Pupae	Adults
1x	1000	417	94	74
Dx	583	323	20	
AM %	58.3	77.46	20.28	
RM %	58.3	32.3	2.0	
IM %	10.57	25.84	2.0	
MSR %	5.83	18.56	22.63	
	2nd generation			
1x	1000	453	125	107
dx	547	328	18	
AM %	54.7	72.41	14.4	
RM %	57.7	32.8	1.8	
IM %	12.92	28.1	1.8	
MSR %	5.47	15.98	11.52	

The same trends were reported for egg and pupal stages in the 2nd generation, while, for the larval stage, the maximum ratio (MSR) was found on cabbage. Generally, for egg, larval and pupal stages, the minimum ratio existed on cotton.

All the values obtained from the above four types of mortality, indicated that the larval stage in the laboratory suffered the greatest mortality. This high percentage of mortality may be due to the photochemical contents of the leaves of the host plants.

3.3. Life table parameters

Table (6) summarizes the life table of *S. littoralis* on the four host plants under laboratory conditions.

3.3.1. Net reproductive rate (Ro)

The net reproductive rate, varied among hosts in different ways in this study. The results indicated that cotton achieved the highest net reproductive rate (R**o**), with means of 592.63 and 593.35, respectively, in the two generations.

Moderate, net reproductive rate (R**o**) was recorded on tomato and cabbage with means of

133.08 and 86.87, respectively, in the 1st generation, and 107.36 & 66.16, respectively, in the 2nd generation. Zorbeyhh showed the least (R**o**) values (21.8, 24.29) in the two generations, respectively. The net reproductive rate (R**o**) is an important indicator of population dynamic (Richard 1961; Varley and Gradwell 1970).

It is a statistic key that summarizes the physiological capability of an animal relative to its reproductive capacity. Comparison of net reproductive rate often provides considerable insight beyond that available from the independent analysis of individual life history parameters (Liu *et al.*, 2004).

3.3.2. Mean generation time (days) (Gt or Tc)

As shown in Table (6), the average generation time (Gt) was obviously the longest 39.38, 38.03 and 36.6 days, when larvae were fed on zorbeyhh, cabbage and tomato leaves, in the 1st generation.

A moderate generation time of 31.21 days took place when *S. littoralis* larvae reared on cotton leaves in the 1st generation. The same trend was observed in the 2nd generation.

3.3.3. Intrinsic rate of increase (rm)

The data in Table (6) revealed the changes in the intrinsic rate of increase (rm) of cotton leafworm moth reared on four host plants. It can be concluded, that the population intrinsic rates decreased (rm) from 0.1988, 0.1336, 0.1174, to 0.0783 individuals / female / day when larvae were fed on cotton, tomato, cabbage and zorbeyhh leaves. In this study, the highest value of intrinsic rate of increase was 0.1988 and 0.1989 individuals / female / day obtained when the larvae were reared on cotton leaves, in the 1st & the 2nd generations.

3.3.4. Finite rate of increase (λ)

The finite rate of increase (λ) of the different host plants (Table 6) were 1.219, 1.143, 1.125 and 1.081 individuals / female / day when larvae were fed on cotton, tomato, cabbage and zorbeyhh leaves, respectively, in the 1st generation. The highest finite rate of increase (λ) of *S. littoralis* was obtained on cotton leaves, 1.219 individuals / female / day, and the lowest was 1.081, individuals/ female / day on zorbeyhh leaves in the 1st generation. The same trend was obtained in the 2nd generation. El- Saadany *et al.*, (1994). The results of this study agreed with concerning the net reproductive rate (Ro), mean generation time (Gt), intrinsic rate (rm) and finite rate (λ) of cotton leafworm moth *S. littoralis* when larvae were fed on cotton leaves.

3.3.5. Population doubling time (Dt)

The population of cotton leafworm moth had to double once every 11.06, 7.39, 6.5 and 4.37 days when the larvae reared on zorbeyhh, cabbage, tomato and cotton leaves, respectively, in the 1st generation. Clearly, cotton leaves appear to be the most preferendum host plants for cotton leafworm moth when population doubling time was considered (Table 6). The same trend was obtained in the 2nd generation. In general, the calculated biological parameters, Ro, Gt. rm, λ and Dt indicated that cotton leaves were quite favorable for achieving the highest developmental and multiplication rates of *S. littoralis*, while, zorbeyhh, cabbage, and tomato leaves were the least. Thus, the results for the net

Table (6): Life table of *S.littoralis* fed on different host plants under laboratory conditions.

Host Plants	Generation	Net Reproductive Rate RO=∑LX. MX	Generation Time(days) Gt= ∑XLXMX/Ro	Intrinsic Rate of Increase rm=Log e^{Ro}/ Tc	Finite Rate of increase λ= $antiloge^{rm}$	Population Doubling Time DT=$Loge^{2}$/rm
Cotton	**1st**	592.63	32.12	0.1988	1.219	4.37
	2nd	593.35	32.10	0.1989	1.220	4.37
Tomato	**1st**	133.08	36.6	0.1336	1.143	6.50
	2nd	107.36	37.0	0.1264	1.35	6.87
Cabbage	**1st**	86.87	38.03	0.1174	1.125	7.39
	2nd	66.16	38.8	0.1080	1.114	8.04
Zorbeyhh	**1st**	21.8	39.38	0.0783	1.081	11.06
	2nd	24.29	38.99	0.0818	1.085	10.62

reproductive rate, the intrinsic rate of population increase indicated that cotton is more favorable than other host plants. Birch (1948) reported that, the intrinsic rate of population increase is a basic parameter which an ecologist may wish to establish for an insect population. Gotelli (1998) revealed that the value of rm determines whether a population increases exponentially (rm > 0), remains constant in size (rm = 0), or declines to extinction (rm < 0). In this study, the intrinsic rate of population increase indicated that *S. littoralis* reared on four host plants exhibited exponential population growth. These findings are similar to those of Greenberg *et al.*, (2001) and Hansen *et al.*, (2004).

Finally, in the ecological study, life table is the most important analytical tool, which provides detailed information of population dynamics to generate simple but more informative statistics. Also it, gives a comprehensive description of the survivorship, development and expectation of life, (Ali and Rizvi 2007).

Intrinsic rate of increase and mean generation time reflect the suitability of the host plant. Where as survival and fecundity are affected by the host plant's nutritional value (Pereyra and Sanchez 2006).

This study provides a foundation regarding the host range of *S. littoralis* and it will be useful for pest management programs.

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دراسة جدول الحياة لفراشة دودة ورق القطن المرباه على خمس عوائل نباتية

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ملخص

تعتبر دودة ورق القطن من أهم آفات القطن ، كما أنها تتغذى على عوائل نباتية أخرى . تم فى هذه الدراسة دراسة معدل التطور والبقاء والإقتدار الحيوى للأعمار اليرقية المختلفة للحشرة خلال جيليين متتاليين على خمسة عوائل مختلفة وهى : (القطن ، الطماطم ،الكرنب ،الزربيح و التوت) تحت الظروف المعملية . أوضحت النتائج المتحصل عليها أن اليرقات أمكنها الحياة على أربع عوائل ولكن فشلت الأعمار اليرقية الصغيرة علي التغذية على العائل الخامس (أوراق التوت) وعليه يمكن ترتيب العوائل الاربعة تنازليا طبقا لملائمتها للحشرة كما يلى (القطن - الطماطم -الكرنب – الزربيح). سجلت نسب الموت الطبيعى بأنواعها انخفاضا معنويا عند تغذية اليرقات على أوراق القطن 9.02 ، 8.50 ،7.44 و 10.02% لكل من النسبة المئوية للموت الظاهرى(AM) ، الموت الحقيقى (RM)، الموت الجوهرى (IM) ونسبة الموت الى البقاء (MSR%)على التوالى. وعلى النقيض أعطت تغذية اليرقات على أوراق الزربيح 77.49 ، 32.30 ، 25.84 و 18.56 % لكل من النسبة المئوية للموت الظاهرى (AM)، الموت الحقيقى(RM) الموت الجوهرى (IM) ونسبة الموت الى البقاء (MSR%)على التوالى. فى نفس الوقت كانت أوراق القطن أكثر ملائمة حيث أعطت أعلى معدل صافى للتزايد (Ro) 593.38 أنثى/أنثى بينما كان أقل معدل صافى للتزايد 21.80 أنثى/أنثى عندما تغذت اليرقات على أوراق الزربيح. وأيضا كان أطول متوسط للجيل (Gt) عندما تغدت اليرقات على أوراق الزيبيح 39.99 يوم. بينما كانت مدة الجيل متوسطة 32.1 يوم عندما تغذت اليرقات على أوراق القطن.

كان معدل الزيادة الطبيعى للمجموع (rm) بتناقص من 0.1989، 0.1336 ، 0.1174 الى 0.0783 فرد/أنثى/يوم وكان معدل الزيادة النهائية (λ) يساوى 1.220 ، 1.135 ، 1.125 ، 1.085 فرد/أنثى/يوم عندما تغذت اليرقات على أوراق القطن ، الطماطم ، الكرنب والزربيح على التوالى. كما أوضحت النتائج أن أعلى معدل زيادة طبيعية (rm) ومعدل زيادة نهائية (λ) ليرقات دودة ورق القطن عندما تغذت على أوراق القطن. كما تضاعف المجموع الحشرى (DT) مرة كل 4.37 ، 6.87، 8.04 ، 11.62 يوما عندما تغذت اليرقات على أوراق القطن ، الطماطم ، الكرنب والزربيح على التوالى.