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LIFE TABLE PARAMETERS OF THE COTTON LEAFWORM, *Spodoptera littoralis* (BOISD.)(LEPIDOPTERA:NOCTUIDAE) ON DIFFERENT HOST PLANTS.

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ABSTRACT

Present work is carried out to study the effect of different hot plants on life table parameters of the cotton leafworm *Spodoptera littoralis* (Boisd.) under laboratory conditions. In this study, development rate, age-specific survival and age and age-specific fecundity for cotton leafworm larvae reared on six host plants: (turnip, bean , corn , castor bean , cowpea and siris) under laboratory conditions were studied for two successive generations. Results obtained revealed that the cotton leafworm larvae survived on four host plants, but on the fifth host (cowpea), most moths died during first two days after emergence, in the same time on the sixth host (siris), young larvae failed to survive. The remaining four host plants could be arranged according to their suitability for insect development in the following descending order castor bean, bean, corn and turnip. The lowest percentage of natural mortality values occurred 6.01, 5.9, 5.54 and 0.61% when the larvae fed on castor bean leaves for AM, RM, IM and MSR% mortality respectively. Meanwhile, the highest mortality rates were 62.56, 36.1, 32.09 and 10.84% for AM, RM, IM and MSR% mortality respectively when larvae fed on turnip leaves. On the same time, castor bean leaves harbored the highest net reproductive rate (Ro) 687.97 females/female. While the shortest reproductive rate 99.36 females/female were obtained when larvae fed on turnip leaves. Also, the longest mean generation duration (Gt) was 31.92 days when larvae were fed on corn leaves, while, moderate duration was 29.94 and 28.31 days when larvae were fed on castor bean and turnip respectively.

The population intrinsic rate (rm) decreases from 0.2182, 0.1792 to 0.1736 individuals/female/day and the finite rate of increase (λ) yield 1.244, 1.196, 1.91, and 1.189 individuals /female/ day when larvae fed on castor bean leaves, bean leaves, corn leaves and turnip leaves respectively. The highest intrinsic and finite rates of increase of *S. littoralis* were obtained when larvae fed on castor bean leaves. The population of cotton leafworm moth doubled once every 3.98, 4.85, 4.96 and 5.0 days when larvae fed on castor bean leaves, bean leaves, corn leaves and turnip leaves respectively.

INTRODUCTION

The cotton leafworm, *Spodoptera littoralis* (Boisd.) (Lepidoptera: Noctuidae) is one of the most destructive phytophagous lepidopterous pests in Egypt. Where it causes various ravages not only for cotton plants but also for other field crops and vegetables (Hosny, *et al*., 1986). The effect of larval diet on the biology of this pest has been studied by many authors (Badr, 1967 and Patel *et al*., 1968.) Also, Moussa, *et al*., (1960) mentioned that approximately 112 plant species belonging to 44 families are found of the

cotton leafworm, in tropical and temperate zones of the old world. These plants include 73 species recorded from Egypt. Moreover, the cotton leafworm, *S. littoralis* has long been a major polyphagous pest .Widely distributed throughout Africa, Mediterranean Europe, and several parts of Asia (Azab *et al*., 2001). Larvae of this pest can feed on 90 economically important plant species belonging to 40 families (Brown and Dewhurst 1975) .Some authors namely (Risk *et al*., 1988 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. Velasco and Walter (1993) reported that survival of insects and larvae in the growth and reproductive phase were highly influenced by food and quality. The effects of different food resources on population parameters were observed in *Earias vitella* (Lepidoptera: Noctuidae) fed on different host plants (Satpute *et al*., 2005) Diaphorina Citri fed on four different host plants (Tsai and Liu 2000). In same direction, Van Lenteren and Noldus (1990) reported that a short developmental time and high levels of reproductive on a host reflect suitability of the plants tested. If the tested host plants are different, the values of population parameters will vary. longevity, population fluctuation, reproductive rates and growth rates could be influenced by their food sources (host plants).In ecological study by (Ali and Rizvi. 2007) reported that life table is a most important analytical tool, which provides detailed information of population dynamics to generate simple but more informative statistics. Laboratory investigation on the development time and fecundity as well as life table of the olive leaf moth *Palpita unionalis* on different host plants were studied by Nabi *et al*., 2007. They indicated that, there is no information about life table parameters for *S. littoralis* on all host plants. So, demographic data could help assess the potential of population increase on cotton plant as well as other host plants found around cotton area. Also, life tables could help explain why *S. littoralis* outbreaks occur in cotton area in our Governorates. Therefore, the aim of the present study was to determine the effect of six host plants such as turnip, bean, corn, castor bean, cowpea and siris on the development, survival, reproduction and life table parameters on each host and mortality distribution of the cotton leafworm, *S. littoralis* in the laboratory.

MATERIALS AND METHODS

Host plants:

Six host plants were used in this investigation namely:

1. Turnip, Brassica compostris var, rapa (Fam. Cruciferae).
2. Bean, Vicia faba var. vulgaris (Fam. Leguminosae).
3. Corn or Maize, zea mays L. (Fam. Gramineae).
4. Castor bean oil, Ricinus communis (Fam. Euphorbiaceae).
5. Cowpea, Vigna sinensis Endl. (Fam. Leguminosae).
6. Siris, Campanula Rapunculus L. (Fam. Campanulaceae).

Three hosts (turnip, bean and cowpea) belonging to vegetable, corn belonging to field crops plus siris is belonging to weeds and the last one (castor bean oil) belonging to trees. The six host plants are belonging to five

families. Two hosts (bean and cowpea) belonging to the same family (leguminosae)

Four plants were cultivated in the field but the other two(siris and castor bean oil) collected from neighboring, trees of castor bean oil and berseem field, to provide satisfactory amounts of fresh leaves daily. Routine agricultural practices were conducted for cultivated the four host plants and no insecticidal treatments were applied.

Test insect:

Cotton leafworm larvae were obtained from egg batches 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 temperature of 27 ± 2 C° and average R.H of 65 ± 5 % were recorded during the course of the present study.

Feeding tests:

One hundred newly hatched larvae were fed each on one of the six host plant leaves. Ten replicates were used for each host plant, where 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 carried out every day for each replicate until feeding ceased in pre-pupa. Then the pupae were kept separate in vial till the moths emerged. Pairs of newly emerged adults were kept in glass jars and 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.

Functions life table parameters:

Constructions of the life tables were done according to the procedures described by Birch (1948) and Southwood (1978) .

The life table fecundity schedule was constructed with the following parameters :

1- Life table.

X: The pivotal age for the age class in units of time (days)

lx: The number of surviving individual at the beginning of age class x.

Lx: The number of individual alive between age x and x+1.

Tx: Total number of individual x age units beyond the age.

dx: The number of individual dying during the age interval x.

Ex: The expectation of life remaining for individual of age x.

• Apparent mortality percentage (AM%)=

$$\frac{dx\,1}{lx\,1}\ 100\ ,\qquad \frac{d\,x\,2}{lx\,1}\ 100\ \ldots.$$

- Real mortality (RM %) = (dx/10) 100
- Indispensable mortality (IM%)
- Mortality – survivor ratio (MSR%)

2- Fecundity schedule

X: Pivotal age for the age class in units of time.

Lx: Number of females surviving at the beginning of age class x (given as fraction of 1.0).

MX: Number of female eggs laid by age class x.

LX.MX: Total number of female eggs laid in age class x.

Ro: Net reproductive rate. It is equal to the sum of the LX.MX or Ro= ∑LX.MX.

T: Cohort generation time (in days) approximated by

$$T = \frac{\sum XLX.MX}{\sum LX.MX}$$

r : Innate capacity for increase, calculated by.

rc = Ln Ro/Tc.

rm: The maximum population growth, the intrinsic rate of natural increase or the innate capacity for increase calculated by rm = $\frac{\text{Log } e^{Ro}}{T_C}$

λ : The finite rate of increase number of female offspring per female per day. Calculated by = Antilog e^{rm}.

DT: Doubling time, the number of days required by a population to double, calculated by DT = Ln 2/r.

RESULTS AND DISCUSSION

Biological aspects:

Data in Table (1 and 2) showed that, the shortest mean incubation periods recorded for eggs of 1st generation were 3.0 ± 0.0, 3.1 ± 0.08 and 3.4± 0.13 days on castor bean, cowpea and turnip respectively. However, the highest mean was 3.9 ± 0.16 days on bean. The same results were obtained in the 2nd generation.

Data in table(1) show that there were differential patterns of tested plants are not exclusive to specific plant, as it had been shown in obtained results that turnip revealed the lowest larval duration (12.56±0.37) day in the 1st generation but corn represented the longest larval duration (18.34±0.13) days. Additionally, bean and cowpea have resulted in the same influence on larval duration was (16.21±0.06 and 16.01±.51) days for the larval fed on bean and cowpea, respectively.

The same trend was observed with the 2nd generation. Moussa *et al.*, 1960; Badr 1967 and Nasr, *et al*., 1973 reported that, some hosts such as castor bean and cowpea tended to the same duration of the larval stage.

Slight difference was found in pupal duration after feeding *S. littoralis*

1st instar larvae on different host plants, whereas, the pupal duration ranged between (7.3±0.05 and 8.69±0.14) days for corn and castor bean respectively.

The same trend was observed with the 2nd generation. Badr (1967) stated that the larval diet had some influence on the pupal period. Also, the above mentioned findings are in agreement with those found by Salama *et al.,* (1971); Nasr *et al*., (1973) and El-Saadany *et al*., (1994).

Considering pupation percentage, it is shown that there was clear difference in pupation percentages between different host plants after feeding the 1st instar larvae of *S. littoralis* on host plants. Cowpea represented the highest reduction in pupation percentage while % pupation was 19.50±0.05 %. Percent pupation of S. littoralis larvae after feeding on turnip plants was 37.50 ± 5.45, while it was 57.50 ± 2.17 and 77.50 ± 2.17 after feeding on bean and corn, respectively.

In contrary castor bean had no effect on pupation percentage, whereas, pupation percentage was 100%. The same trend was observed with the 2nd generation.

Regarding adult emergence, data in table (1 and 2) indicated that there were slight differences was found in adult emergence between different tested host plants while, adult emergence percentages were ranged between (80.80 ± 2.92, 79.76 ± 2.42) and (95.83 ± 3.16, 100.00 ± 0.00) % in the first and second generation respectively.

Both cowpea and siris stopped the pupal and adult stages due to their contents of secondary metabolites. Cowpea plants contain different derivatives of monoterpens such as β-caryphyllene and pinene which have inhibitory effects on insect developmental stages (Balkall *et al.*, 2008)

In both generations the sex ratio did not differ from a 1:1 ratio, results also, showed that, larvae fed on castor bean leaves gave the highest fecundity, on the other hand; Turnip gave the lowest percentage of hatchability in both generations.

It is appear that plant components are responsible for this variation in larval duration through the 1st generation. Castor bean leaves contain two important secondary metabolites. These are Ricin and Ricinine (1-methyl-3-cyano-4-methoxy-2- pyridine). Such secondary metabolites inhibit protein biosynthesis which is considered the most important element for development of different insect stages (Olaiba *et al*., 1991).

In addition, it is found that feeding *S. littoralis* 1st instar larvae on campanula rapuncules leaves stopped the development of larvae after the 3rd instar. This result is due to contents of leaves from the secondary metabolites such as tannins, resins and garlic acid. Both garlic acid and tannic acid showed growth inhibitory activity after feeding assay of *Pectinophera gossypiella* larvae (Pieron ,2000). Thus S. littoralis larvae fed on *C. rapunculus* leaves were not be able to complete their development because of the inhibitory activity of garlic acid and tannic acid and their correlation with tyrosinase inhibitory activity and resulting in disrupting insect phenyl oxidase (PO) activity, in complete cuticle hardening and darkening (Kamer and Hopkins, 1987 and Kubo, 1997).

This suggests that castor bean leaves proved to be the most host suitable plant for larval growth and development. However; cowpea and siris were not suitable for cotton leafworm *S. littoralis*.

Also, castor bean leaves proved to be the most favorable host plant for egg production, Where moths originating from larvae fed on castor bean plant laid the highest number of eggs (2171 ± 117.5) and (2139.6 ±51.5) in both generations, respectively. Female moths were observed by Hosni and Kotbi (1960) to prefer egg laying on the same host plant. 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 tabulated in four Tables (4-6).

Table (1): Biological effects of different host plants on the cotton leafworm, *S. littoralis* for the first generation.

Stages	Host plants Mean duration ± SE					
	Turnip	**Bean**	**Corn**	**Castor bean**	**Cowpea**	**Siris**
Egg	3.4 ± 0.13	3.9 ± 0.16	3.7 ± 0.12	3.0 ± 0.0	3.1 ± 0.08	3.7 ± 0.16
larval instars 1st instar	1.87 ± 0.07	1.96 ± 0.02	2.17 ± 0.1	1.76 ± 0.17	2.0 ± 0.16	2.1 ± 0.11
2nd instar	2.03 ± 0.08	2.17 ± 0.03	2.31 ± 0.17	2.17 ± 0.22	2.3 ± 0.16	2.2 ± 0.13
3rd instar	2.07 ± 0.11	2.63 ± 0.02	2.49 ± 0.14	2.37 ± 0.25	2.5 ± 0.08	2.3 ± 0.08
4th instar	2.13 ± 0.08	2.97 ± 0.03	3.11 ± 0.25	2.51 ± 0.16	2.06 ± 0.05	Zero ± 0.0
5th instar	2.21 ± 0.16	3.07 ± 0.04	3.7 ± 0.18	2.73 ± 0.16	3.2 ± 0.12	
6th instar	2.34 ± 0.16	3.41 ± 0.08	4.56 ± 0.21	3.52 ± 0.17	3.5 ± 0.05	
Larval duration	12.56 ± 0.37	16.21 ± 0.06	18.34 ± 0.13	15.06 ± 0.07	16.1 ± 0.51	
Pupal duration	7.37 ± 0.14	8.05 ± 0.02	7.3 ± 0.05	8.69 ± 0.14	8.01 ± 0.08	
Pupation %	37.5 ± 5.45	57.5 ± 2.17	77.5 ± 2.17	100.0 ± 0.0	19.5 ± 0.05	
Adult emergence%	88.7± 5 5.7	95.83 ± 3.16	80.8 ± 2.92	95.0 ± 2.5	Zero ± 0.0	
sex ratio						
Male	33.69 ± .031	35.76 ± 0.1	37.37 ± 0.24	36.08 ± 0.09		
Female	32.51 ± 0.29	36.47 ± 0.28	35.65 ± 0.21	35.76 ± 0.35		
No.off egg/female	1973.6 ± 79.6	1570.1 ± 27.1	1180.2 ± 31.7	2171.8 ± 117.5		
Hatchability %	57.7 ± 0.12	77.3 ± 0.15	71.7 ± 0.14	98.1 ± 0.21		

1- Apparent mortality (AM):

At egg stage, the apparent mortality was observed maximum (42.3%) at turnip and minimum (19.0 %) at castor bean in the 1st generation. The same result was recorded in the 2nd generation, where the maximum (AM) value was (45.8%) in the case of turnip while the minimum (AM) values was (4.3 %) at castor bean.

The highest larval mortality expressed as AM was found after feeding on turnip 62.36, while castor bean resulted in the lowest AM recording 6.01. Regarding the pupal stage, corn gave the highest mortality reached to 19.24, but bean recorded the lowest one in the first generation.

2- Real mortality (RM):

Regarding real mortality, data in table (3) indicated that turnip gave the highest real mortality, while castor bean gave the lowest real mortality.

3- Indispensable mortality (IM):

Indispensable mortality (IM) at egg stage was recorded maximum (36.41 %) for turnip and minimum (1.68%) for castor bean in the 1st generation. The same trend was obtained in the 2nd generation .Also; indispensable at larval stage was recorded maximum (32.9%), (32.5%) for turnip and minimum (5.54%), (6.16%) for castor bean respectively in both generations. Likewise, the IM for pupae were recorded maximum (10.7 %) for corn, while, the minimum IM (1.9 %) was recorded for bean in the 1st generation. The same trend was obtained in the 2nd generation.

Table (2): Biological effects of different host plants on the cotton leafworm, *S. littoralis* for the second generation.

Stages	Host plants Mean duration ± SE					
	Turnip	**Bean**	**Corn**	**Castor bean**	**Cowpea**	**Siris**
Egg	3.3 ± 0.13	4.13 ± 0.11	3.6 ± 0.11	3.0 ± 0.0	3.2 ± 0.16	3.6 ± 0.08
larval instars 1st instar	1.97 ± 0.02	2.01 ± 0.07	2.1 ± 0.11	1.81 ± 0.21	1.9 ± 0.08	2.2 ± 0.13
2nd instar	2.02 ± 0.15	2.15 ± 0.11	2.27 ± 0.08	2.07 ± 0.2	2.3 ± 0.08	2.3 ± 0.16
3rd instar	2.17 ± 0.03	2.45 ± 0.16	2.52 ± 0.15	2.47 ± 0.1	2.4 ± 0.16	2.4 ± 0.11
4th instar	2.27 ± 0.16	3.07± 0.14	3.17 ± 0.13	2.57 ± 0.11	2.6 ± 0.08	Zero ± 0.0
5th instar	2.33 ± 0.16	3.33 ± 0.13	3.67 ± 0.16	2.19 ± 0.21	3.1 ± 0.05	
6th instar	2.41 ± 0.13	3.53 ± 0.14	4.55 ± 0.1	3.82 ± 0.27	3.5 ± 0.16	
Larval duration	13.17 ± 0.22	16.54 ± 0.18	18.28 ± 0.15	15.65 ± 0.11	15.8 ± 0.53	
Pupal duration	7.44 ± 0.17	7.97 ± 0.11	7.21 ± 0.05	8.63 ± 0.14	7.8 ± 0.07	
Pupation %	40.0 ± 5.54	55.0 ± 2.5	72.5 ± 4.15	100.0 ± 0.0	17.2 ± 0.16	
Adult emergence%	88.75 ± 5.7	86.67 ± 2.07	79.76 ± 2.42	100.0 ± 0.0	Zero ± 0.0	
sex ratio						
Male	34.36 ± 0.36	36.89 ± 0.45	37.29 ± 0.17	36.84 ± 0.04		
Female	33.31 ± 0.27	36.74 ± 0.11	35.38 ± 0.22	36.74 ± 0.15		
No.off egg/female	1914.2 ± 30.1	1475.7 ± 30.7	1030.1 ± 35.6	2139.6 ± 51.5		
Hatchability %	54.2 ± 0.10	79.0 ± 0.21	70.0 ± 0.21	95.7 ± 0.13		

4- Mortality survivor ratio (MSR):

Mortality survival ratio, at egg stage was found maximum (4.23%) for turnip. Among larval stage the maximum (10.84%) was recorded for turnip. On the other hand, the minimum ratio at egg stage (1.9%) was obtained for castor bean. Among larval stage the minimum (0.61%) was recorded for castor bean. On the same time, when pupal stages were examinal, the highest (MSR) (5.14%) was observed for turnip.

Table (3): The changes in the number of survival and mortality types in each age- classes of *S. littoralis*, when larvae fed on bean leaves for 1st and 2nd generations.

Measure age class	1st generation			
	Stages			
	Eggs	Larvae	Pupae	Adults
1x	1000	773	444	425
Dx	227	329	19	
Apparent mortality (A.M %)	22.70	42.60	4.20	
Real mortality (R. M %)	22.70	32.90	1.90	
Indispensable mortality (I.M %)	12.44	31.49	1.90	
Ratio (M.S.R) %	2.27	5.50	0.96	
	2nd generation			
1x	1000	790	435	377
dx	210	355	48	
A.M %	21.00	44.94	13.33	
R.M %	21.00	35.50	5.80	
I.M %	10.02	30.77	5.80	
M.S.R %	2.10	5.70	3.10	

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

Measure age class	1st generation			
	Stages			
	Eggs	Larvae	Pupae	Adults
1x	1000	577	216	192
Dx	423	361	24	
A.M. %	42.30	62.56	11.11	
R.M. %	42.30	36.10	2.40	
I.M. %	36.41	32.09	2.40	
M.S.R %	4.23	10.84	5.14	
	2nd generation			
1x	1000	542	217	193
dx	458	325	24	
A.M %	45.80	59.96	11.10	
R.M %	45.80	32.50	2.40	
I.M %	34.00	28.88	2.40	
M.S.R %	4.58	11.10	5.10	

Table (5): The changes in the number of survival and mortality types in each age- classes of *S. littoralis*, when larvae fed on corn leaves for 1st and 2nd generations.

Measure age class	1st generation			
	Stages			
	Eggs	Larvae	Pupae	Adults
1x	1000	717	556	449
Dx	383	161	107	
A.M. %	38.30	22.45	19.24	
R.M. %	38.30	16.10	10.70	
I.M. %	17.73	13.00	10.70	
M.S.R %	3.83	3.13	3.46	
	2nd generation			
1x	1000	700	508	405
dx	300	192	103	
A.M %	30.00	27.43	20.28	
R.M %	30.00	19.20	10.30	
I.M %	17.35	15.3	10.30	
M.S.R %	3.00	3.92	3.99	

Table (6): The changes in the number of survival and mortality types in each age- classes of *S. littoralis*, when larvae fed on castor bean leaves for 1st and 2nd generations.

Measure age class	1st generation			
	Stages			
	Eggs	Larvae	Pupae	Adults
1x	1000	981	922	867
Dx	19.00	59.00	55.00	
A.M. %	19.00	6.01	5.97	
R.M. %	19.00	5.90	5.50	
I.M. %	1.68	5.54	5.50	
M.S.R %	1.90	0.61	0.65	
	2nd generation			
1x	1000	957	890	819
dx	43	67	71	
A.M %	4.30	7.00	7.98	
R.M %	4.30	6.16	7.10	
I.M %	3.68	6.16	7.10	
M.S.R %	0.43	0.73	0.90	

Table (7): Summary of *S. littoralis* life table fed on different host plants in laboratory.

Host Plants	Generation	Net Reproductive Rate RO=∑LX. MX	Generation Time(days) Gt = ∑XLXMX/Ro	Intrinsic Rate of Increase rm=Log eRo/ Tc	Finite Rate ofincrease λ = antilogerm	Population Doubling Time DT=Loge2/rm
Turnip	1st	111.41	27.15	0.1736	1.189	5.00
	2nd	99.36	28.31	0.1624	1.176	5.35
Bean	1st	268.34	31.21	0.1792	1.196	4.85
	2nd	250.2	31.38	0.1759	1.192	4.94
Corn	1st	263.59	31.85	0.1750	1.191	4.96
	2nd	252.66	31.92	0.1733	1.189	5.01
Castor bean	1st	254.27	29.72	0.2182	1.244	3.98
	2nd	687.97	29.94	0.2182	1.244	3.98

Life table parameters:

Table (7) summarized the life table of *S. littoralis* on the studied six host plants under laboratory conditions.

1- Net reproductive rate (Ro):

The net reproductive rate (A.), varied among hosts in different ways in this study. The obtained results indicated that castor bean achieved the highest net reproductive rate (654.27 and 687.97) were recorded for this host plant in both two generations respectively.

Moderate, net reproductive rate were recorded on bean and corn. Means of 268.34 and 263.59 respectively in the 1st generation, compared with 250.2 and 252.66 for the hosts respectively in the 2nd generation.

Turnip showed the lowest (Ro) values i.e. (111.41, 99.36) for both generations respectively.

The net reproductive rate (Ro) is an important indicator of population dynamics (Richard 1961; Varley and Gradwell 1970).

It is a key statistic 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). Also, the net reproductive rate may reflect the potential of host plants to contribute to cotton leafworm moth populations.

2- Mean generation time (days) (G.t or Tc):

As shown in Table (7), the average generation time (Gt) was obviously the longest i.e. 31.21and 31.85 days, when the larvae were fed on bean leaves and corn leaves respectively. Meanwhile, the shortest mean generation time 27.15 days was obtained when larvae were fed on turnip leaves. A moderate generation time of 29.72 days took place when larvae reared on castor bean leaves in the 1st generation. The same trend was observed in the 2nd generation. Seth and Sharma (2001) found that the mean generation time GT was 31.3 days when larvae fed on castor bean leaves.

3- Intrinsic rate of increase (rm):

The data in Table (7) revealed that the changes in the intrinsic rate of increase (rm) of cotton leafworm moth reared on four host plants. From these yield results it can be concluded, however that the population intrinsic rates decreases (rm) from 0.1736, 0.1792, 0.1750, to 0.2182 individuals / female / day when larvae fed on turnip leaves, bean leaves, corn leaves and castor bean leaves, the highest value of intrinsic rate of increase 0.2182 individuals / female / day was obtained when the larvae were reared on castor bean leaves. The same trend was obtained in the 2nd generation.

4- Finite rate of increase (λ):

When the finite rate of increase (λ) for the different host plants Table (7) values were worked out it yielded 1-189, 1.196, 1.191 and 1.244 individuals / female / day when larvae fed on turnip leaves, bean leaves, corn leaves and castor bean leaves respectively. It is obvious from the obtained data that the highest finite rate of increase (λ) of *S. littoralis* was obtained for castor bean leaves, 1.244 individuals / female / day in the 1st generation. The same trend was obtained in the 2nd generation.

El- Saadany *et al*., (1994) found that the net reproductive rate (Ro), mean generation time (Gt), intrinsic rate (rm) and finite rate (λ) of cotton leafworm were 506.41, 27.16, 0.24 and 1.27 respectively, when larvae fed on castor bean leaves. Also, Seth and Sharma (2001), confirmed the previous results for the net reproductive rate (Ro), mean generation time (Gt), intrinsic rate ™ and finite rate (λ) of cotton leafworm moth *S. littoralis* were785.2, 31.3, 0.2129 and 1.237 respectively, when larvae fed on castor bean leaves.

5- Population doubling time (D.t):

The population of cotton leafworm moth had to double once every 5.0, 4.85, 4.96 and 3.98 days when the larvae feeding on turnip leaves, bean leaves, corn leaves and castor bean leaves respectively in the1st generation. Data in Table (7) revealed that castor bean appears to be the most preferrendum host plants for cotton leafworm moth when population doubling time was considered. The same trend was obtained in the 2nd generation. In general the calculated biological parameters Viz. Ro, Gt. Rm, λ and Dt indicated that castor bean leaves seem to be quite favorable for achieving the highest developmental and multiplication rates of *S. littoralis*, followed by bean leaves, corn leaves and turnip leaves.

These results of the net reproductive rate (Ro), the intrinsic rate of population increase (Rm) indicated that castor bean is more favorable than other host plants. Birch (1948) reported that, the intrinsic rate of population

increase is a basic parameter which an ecdogest may wish to establish for an insect population. Thus the intrinsic rate of population increase indicated that *S. littoralis* reared on six host plants exhibited exponential population growth. These findings were consistent with those of Greenberg *et al.*, (2001) on *Spodoptera exigua* (Hübner) and Hansen
et al., (2004) on *Sitotroga cerealella* (Olivier).

Finally, this study revealed that demographic parameters obtained from *S. littoralis* reared on six host plants under laboratory condition are useful for the assessment of host plant quality.

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جدول الحياة لفراشة دودة ورق القطن من رتبة حرشفية الاجنحة و المرباه على عوائل نباتية مختلفة

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تعتبر فراشة دودة ورق القطن والتابعة لرتبة حرشفية الاجنحة من أهم الآفات الحشرية فى مصر.

تم دراسة معدل التطور والبقاء والاقتدار الحيوى للاعمار المختلفة للحشرة خلال جيليين متتاليين على ستة عوائل مختلفة وهى : (اللفت ، الفول ،الذرة ،الخروع ،اللوبيا و السريس) تحت الظروف المعملية

أوضحت النتائج المتحصل عليها أن اليرقات أمكنها الحياة على أربع عوائل أما بالنسبة للعائل الخامس (أوراق اللوبيا) فقد ماتت معظم الفراشات بعد الخروج بيومين.فى نفس الوقت ماتت الاعمار الاولى لليرقات عند التغذية على العائل السادس (أوراق السريس) . وعليه يمكن ترتيب العوائل الاربعة المتبقية طبقا لملائمتها للحشرة كما يلى (الخروع - الفول - الذرة - اللفت).

سجلت نسب الموت الطبيعى بأنواعها انخفاضا معنويا عند تغذية اليرقات على أوراق الخروع ٦.٠١ ، ٥.٩٠ ،٥.٥٤و ٠.٦١% 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 اللفت ٦٢.٥٦ ، ٣٦.١٠ ، ٣٢.٠٩ و ١٠.٨٤% 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 الخروع أكثر ملائمة حيث أعطت معدل صافى للتزايد (Ro) 687.97أنثى/أنثى بينما كان أقل معدل صافى للتزايد ٩٩.٣٦ أنثى/أنثى عندما تغذت اليرقات على أوراق اللفت. وأيضا كان أطول متوسط للجيل (Gt) عندما تغذت اليرقات على أوراق الذرة ٣١.٩٢ يوم. بينما كانت مدة الجيل متوسطة ٢٩.٩٤ ، ٢٨.٣١ يوم عندما تغذت اليرقات على أوراق الخروع وأوراق اللفت على التوالى.

كان معدل الزيادة الطبيعى للمجموع (rm) بتناقص من ٠.٢١٨٢، ٠.١٧٩٢ ، ٠.١٧٥٠ الى ٠.١٧٣٦ فرد/أنثى/يوم وكان معدل الزيادة النهائية (λ) يساوى ١.٢٤٤ ، ١.١٩٦ ، ١.١٩١ و ١.١٨٩ أنثى/أنثى/يوم عندما تغذت اليرقات على أوراق الخروع ، الفول ، الذرة و اللفت على التوالى.

كما أوضحت النتائج أن أعلى معدل زيادة طبيعية (rm) ومعدل زيادة نهائية (λ) ليرقات دودة ورق القطن عندما تغذت على أوراق الخروع.

وكانت المدة اللازمة لتضاعف المجموع الحشرى (DT) يتضاعف مرة كل ٣.٩٨ ، ٤.٨٥، ٤.٩٦ و ٥.٠٠ يوم عندما تغذت اليرقات على أوراق الخروع ، الفول ، الذرة و اللفت على التوالى.