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Biotic Potential and Life Table of *Helicoverpa armigera* Hubner on Pigeonpea Pods*

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ABSTRACT

Studies on the innate capacity for increase in number of *Helicoverpa armigera* (Hubner) were carried out at a constant temperature of 26 ± 1 °C on pigeonpea pod in 1994. The number that survived from egg to adult was 76 individuals. Under a limited space and sufficient food supply, the population of *H. armigera* increased with an infinitesimal rate (rm) of 0.1365 and finite rate (λ) 1.147 females per female per day. The net reproductive rate (Ro) was 427.94. A generation was completed in 46.06 days. The population was able to multiply 427.94 times per generation on pigeonpea pods. The population on reaching a stable age distribution comprised approximately 99 per cent of immature stages. The expectation of further life at the age interval of 35 to 50 days was reduced to 5.13 days from 16.35 days in the beginning.

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INTRODUCTION

The construction of life table is a vital statistic to the description and understanding of the population dynamics of a species. Such life table may be analysed to determine which stage in the life-cycle cotributes the most to the population. The objective of the present study was to gather appropriate information for the construction of the life tables under laboratory condition, when the larvae were reared on pigeonpea pods.

MATERIALS AND METHODS

A laboratory culture of *Helicoverpa armigera* (Hubner) was used for this study. Known number of adult pairs were released for egg laying in cages. Eggs laid on white muslin cloth were collected by wet camel hair brush and such 100 eggs were kept for hatching in the batches of 10 each. Immediately after hatching, the larvae were transferred on green pods of pigeonpea kept in the plastic containers (5.0 x 5.5 cm). The plastic containers were then kept in BOD incubator at a constant temperature of 26 ± 1 °C. Fresh pigeonpea pods were provided daily as food in the morning till all the larvae pupated. The adults emerged on a particular day were released in separate cages for egg laying. The number of eggs laid on subsequent days were recorded daily till all the females died. The number of eggs laid per female was divided by two (sex ratio 1:1) to get the number of female births (mx). Life tables were constructed according to the method of Birch (1848), Howe (1953) and

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Atwal and Bains (1974). The intrinsic rate of increase (rm), net reproductive rate (Ro) and mean generation time (Tc) were basic parameters used to assess the population growth at a constant temperature of 26 ± 1° C. Stable age-distribution (per cent distribution of various stages) was also worked out by calculating the population schedule of birth rate and death rate (mx and 1x) when grown in a limited space. The life expectancy table was calculated by methods as those summarised by Southwood (1968) and Atwal and Bains (1974).

RESULTS AND DISCUSSION

The maximum duration of egg, larva and pupa were 3, 7 and 16 days, respectively. The number that survived from egg to adult emergence was 76 individuals. The data regrading the life fecundity and age-specific fecundity for *H. armigera* are presented in Table 1 and Fig. 1. The results indicated that pre-oviposition period ranged from 37th to 40th days pivotal age. The first female mortality was observed on 12th day after the emergence of adult female and it increased

TABLE 1

Life table (for female) and age-specific fecundity for *H. armigera* on pigeonpea.

Pivotal age in days x	*Survival of female at different age interval* lx	*Age schedule for female birth* mx	lxmx	xlxmx
0 - 36	0.76	—	—	Immature
37	0.76	—	0.76	28.12
38	0.76	—	0.76	28.88
39	0.76	—	0.76	29.64
40	0.76	—	0.76	30.40
41	0.76	17.05	12.96	531.36
42	0.76	61.50	46.74	1963.08
43	0.76	98.00	74.48	3202.64
44	0.76	112.00	85.12	3745.28
45	0.76	90.00	68.40	3078.00
46	0.76	65.24	49.58	2880.79
47	0.76	50.77	38.59	1813.50
48	0.67	42.82	28.69	1377.09
49	0.46	27.50	12.65	619.85
50	0.41	18.75	7.69	384.38
Σ lxmx =	427.94			Σ xlxmx =19713.01

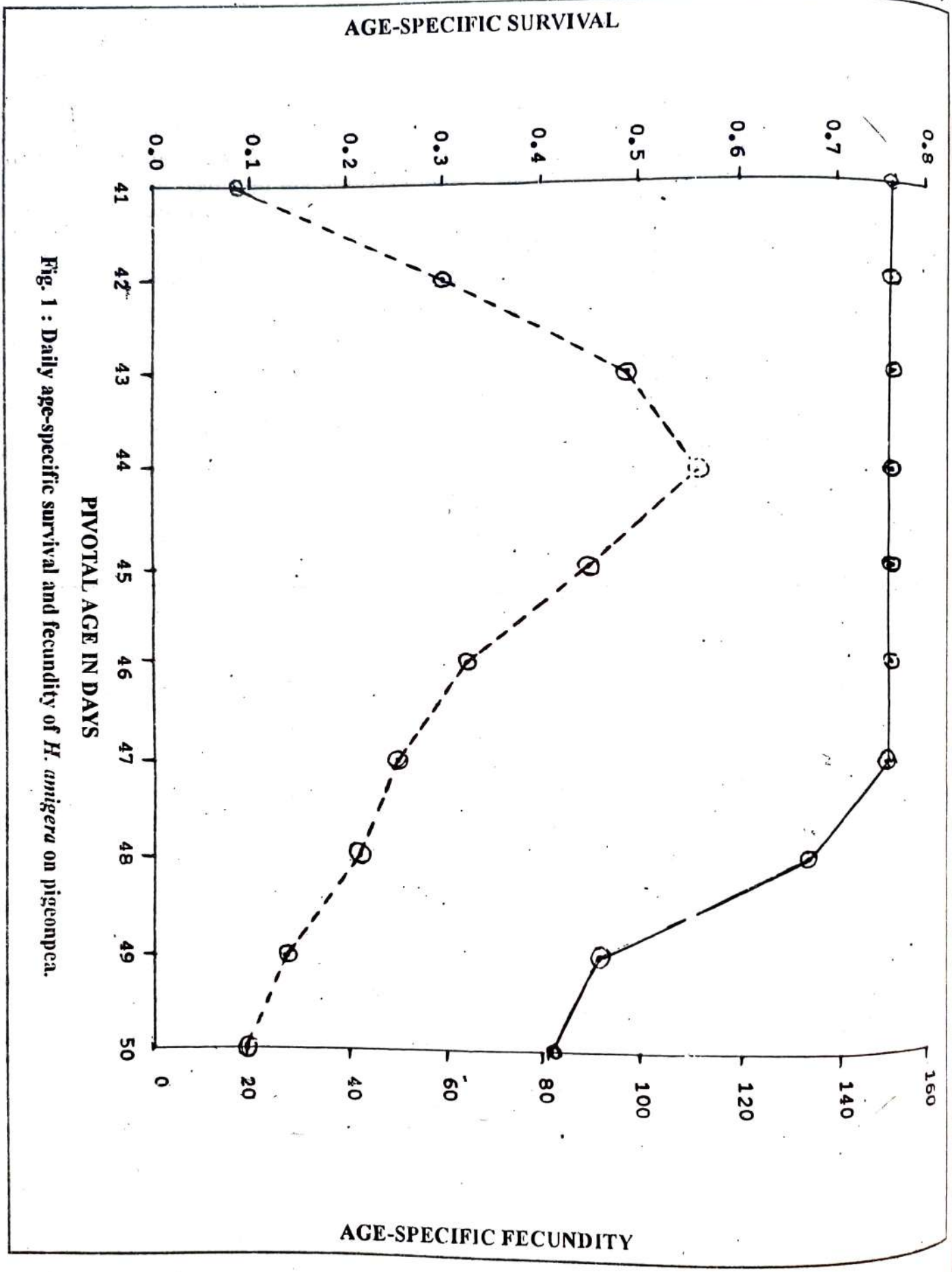

Fig. 1 : Daily age-specific survival and fecundity of *H. amigera* on pigeonpea.

TABLE 2

Mean length of generation, innate capacity for increase in numbers and finite rate of increase in numbers of *H. armigera* on pigeonpea.

Sr. No.	*Population growth statistics*	*Formula*	*Calculated values*	
1.	Net reproductive rate	$Ro = \sum lxmx$	427.94	
2.	Mean length of generation	$Tc = \frac{\sum xlxmx}{Ro}$	46.06	days
3.	Innate capacity for increase in numbers	$rm = \frac{\log_e Ro}{T_c}$	0.1315	Females/ female/ day
4.	Arbitary `rm' (rc)	0.13 and 0.14		
5.	Corrected `rm'	$\sum_c$?rmx.lxmx	0.1365	Females/ female/ day
6.	Correcte generation time	$T = \frac{\log_e Ro}{rm}$	44.23	Days
7.	Finite rate of increase in number	$= \text{antilog}_e^{rm}$	1.147	Females/ females/ day
8.	Weekly multiplication of population	$(\lambda)^7$	2.609	Times
9.	Hypothetical F_1 females	$(Ro)^2$	183132.64	

TABLE 3

Age-specific distribution of *H. armigera* on pigeonpea (rm = 0.1370).

Pivotal age (days) x	*Lx*	$e^{-rm(x+1)}$	$Lx.e^{-rm(x+1)}$	*Per cent contribution*
1.	*2.*	*3.*	*4.*	*5.*
0	1.00	0.8720	0.8720	13.7574
1	1.00	0.7603	0.7603	11.9951
2	1.00	0.6630	0.6630	10.4600
3	0.96	0.5781	0.5550	8.7561
				44.9686

1.	2.	3.	4.	5.
4	0.93	0.5041	0.4688	7.3962
5	0.93	0.4395	0.4088	6.4496
6	0.93	0.3833	0.3564	5.6228
7	0.91	0.3342	0.3041	4.7977
8	0.89	0.2914	0.2594	4.0925
9	0.89	0.2541	0.2262	3.5687
10	0.88	0.2216	0.1950	3.0765
11	0.88	0.1932	0.1700	2.6821
12	0.88	0.1685	0.1482	2.3381
13	0.87	0.1469	0.1278	2.0163
14	0.84	0.1281	0.1076	1.6976
15	0.83	0.1117	0.0927	1.4625
16	0.83	0.0974	0.0808	1.2748
17	0.83	0.0849	0.0705	1.1123
18	0.83	0.0740	0.0615	0.9703
19	0.83	0.0646	0.0536	0.8456
20	0.83	0.0563	0.0467	0.7368
				50.1404
21	0.83	0.491	0.0407	0.6421
22	0.83	0.0428	0.0355	0.5601
23	0.83	0.0373	0.0310	0.4891
24	0.83	0.0325	0.0270	0.4260
25	0.83	0.0284	0.0236	0.3723
26	0.83	0.0247	0.0205	0.3234
27	0.83	0.0216	0.0179	0.2824
28	0.83	0.0188	0.0156	0.2461
29	0.83	0.0164	0.0136	0.2146
30	0.83	0.0143	0.0119	0.1877
31	0.83	0.0125	0.0104	0.1641
32	0.83	0.0109	0.0090	0.1420
33	0.83	0.0095	0.0079	0.1246
34	0.83	0.0083	0.0069	0.1089
35	0.83	0.0072	0.0060	0.0947
36	0.83	0.0063	0.0052	0.0820
				4.4601

1.	2.	3	4.	5.
37	0.79	0.0055	0.0043	0.0678
38	0.76	0.0048	0.0036	0.0568
39	0.76	0.0042	0.0032	0.0505
40	0.76	0.0036	0.0028	0.0442
41	0.76	0.0032	0.0024	0.0379
42	0.76	0.0028	0.0021	0.0331
43	0.76	0.0024	0.0018	0.0284
44	0.76	0.0021	0.0016	0.0252
45	0.76	0.0018	0.0014	0.0221
46	0.76	0.0016	0.0012	0.0189
47	0.76	0.0014	0.0011	0.0174
48	0.67	0.0012	0.0008	0.0142
49	0.46	0.0011	0.0005	0.0095
50	0.41	0.0009	0.0004	0.0063
				0.4322

TABLE 4

Life table for computing life expectancy of *H. armigera* reared on pigeonpea.

Pivotal age (days)	*Numbers surviving to the beginning of age interval*	*Numbers dying during x*	*Mortality per hundred alive at beginning of age interval* $\frac{(d\,x\,.100)}{l\,x}$	*Alive between age x and x + 1* $\frac{l\,x + (lx+1)}{2}$	*Numbers of the individaul's life days beyond x*	*Expectation further life* $\frac{Tx}{lx} \times 2$
(x)	(lx)	(dx)	(100 qx)	(Lx)	(Tx)	(ex)
0 - 5	100	7	7.00	96.50	817.50	16.35
5 - 10	93	5	5.38	90.50	721.00	15.51
10 - 15	88	5	5.68	85.50	630.50	14.33
15 - 20	83	0	0.00	83.00	545.00	13.13
20 - 25	83	0	0.00	83.00	462.00	11.13
25 - 30	83	0	0.00	83.00	379.00	9.13
30 - 35	83	0	0.00	83.00	296.00	7.13
35 - 40	83	7	8.43	79.50	213.00	5.13
40 - 45	76	0	0.00	76.00	133.50	3.51
45 - 50	67	28	41.79	57.50	57.50	1.72

slowly thereafter. The female contributed highest (mx = 112.00) in the life cycle on 44th day of pivotal age. The net reproductive rate (Ro), representing the total female births was 427.94. Thus, the population would be able to multiply 427.94 times per generation on pigeonpea pods.

The data on intrinsic rate of increase (rm) and finite rate of natural increase in numbers (λ) are summarised in Table 2. It is evident from data that innate capacity for increase in numbers (rm) was 0.1365 females per female per day with a daily finite rate of increase (λ) 1.147 females per female per day. The population would multiply 2.609 times every week. The mean generation time was 44.23 days. The hypothetical female population in F_2 generation was 183132.64.

On reaching stable age-distribution, the population of *H. armigera* in its various stages, viz., eggs, larvae, pupae and adults contributed to the extent of 44.97, 50.14, 4.46 and 0.43 per cent, respectively (Table 3).

The life expectancy table was constructed and results are presented in Table 4. The life expectancy (ex) of newly deposited eggs was only 16.35 days. The mortality rate was comparatively high at the age of 35 to 40 days when expectation of further life was reduced to 5.13 days from 16.35 days in the beginning. The present findings on different parameters of life tables of *H. armigera* on pigeonpea also falls in line with the report of Bilapate *et al.* (1982).

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