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Life Table and Innate Capacity of Increase of *Helicoverpa armigera* (Hubner) Hardwick on Sunflower

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ABSTRACT

The gram podborer, *Helicoverpa armigera* (Hubner) Hardwick is a pest feeds on many cultivated and non-cultivated host plants. Studies were carried out to determine the multiplication rate of its population on sunflower at 26 ± 1°C. The maximum duration of egg, larva and pupa was 3.18 and 15 days, respectively. The net reproductive rate (Ro) representing the total female births was 489.23. The population increased with an infinitesimal rate (rm) of 0.1396 and finite rate (λ) of 1.150 females per female per day on this host. The mean generation time (Tc) was 44.66 days. On reaching the stable age distribution, the eggs, larvae, pupae and adults contributed to the tune of 45.78, 50.05, 3.70 and 0.41 per cent, respectively. The expectation of further life at the age of 30 to 35 days was reduced to 7.80 days from 17.05 days in the beginning.

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INTRODUCTION

The gram podborer, *Helicoverpa armigera* (Hubner) Hardwick is one of the most destructive and polyphagous pests having worldwide distribution. Life tables are the most useful tool to make quantitative and qualitative evaluation of different host plants. The statistic is used to determine which stage contributes the most in the life cycle of a pest. The life tables developed by Birch (1948) can be successfully used to determine the growth statistics and further applied to estimate the potential increase of insect reared on different hosts. The information on sunflower for *H. armigera* is very scanty. Therefore, an attempt was made to construct the life table on this crop.

MATERIALS AND METHODS

In order to construct the life-fecundity tables, 100 eggs were kept in BOD incubator at a constant temperature of 26 ± 1°C in 10 batches in plastic boxes (5.0 x 5.5 cm). The eggs were glued with the help of a soft wet camel hair brush on the white paper in one row to facilitate observations on hatching. After hatching, all the larvae were reared individually on sunflower heads. Fresh food was supplied daily. Observations on hatching,

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age-specific mortality of eggs, larvae, pupae and adults were recorded daily. For determining the age-specific fecundity, the total number of adults emerged on a particular day were transferred to a separate cage for egg laying. The eggs laid by the females on subsequent days were noted 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). A life table was constructed according to the method of Birch (1948), Howe (1953) and Atwal and Bains (1974). The innate capacity for increase in numbers (rm) was calculated from the data in the life-table. The values of x (pivotal age in days), lx (survival of female at different age interval) and mx (number of female progeny per female) were worked out.

The stable age-distribution (distribution percentage of various age-groups) was also worked out by observing the population schedule of birth rate and death rate (mx and lx).

RESULTS AND DISCUSSION

The data on survival of different stages of *H. armigera* during developmental period on sunflower are presented in Table 1. It has been observed that there was 11 per cent mortality in egg stage. The maximum duration of egg, larva and pupa were 3.18 and 15 days, respectively. The number that survived from egg to adult emergence was 80 individuals. The data regarding the life fecundity and age-specific fecundity for this pest are presented in Table 2 and Fig. 1. It is evident from the data that immature stages lasted for 36 days. The pre oviposition period ranged from 37th to 40th day of pivotal age. The first female mortality within the cohort occurred on tenth (1x = .76) day after the emergence of adults and mortality increased thereafter. The females contributed the highest egg production (mx = 115.13) in the life cycle on 44th day and the lowest (mx = 2036) on 50th day of pivotal age. The reproduction ceased by tenth day after starting

TABLE 1

Survival of different stages of *H. armigera* during development on sunflower.

No. of eggs	*Numbers survival*		
	Egg stage (0 to 3 days)	*Larval stage (4 to 21 days)*	*Pupal stage (22 to 36 days)*
10	9	7	6
10	9	9	8
10	9	9	9
10	9	9	9
10	9	8	8
10	9	7	6
10	9	9	8
10	10	10	10
10	8	8	8
10	8	8	8
100	89	84	8

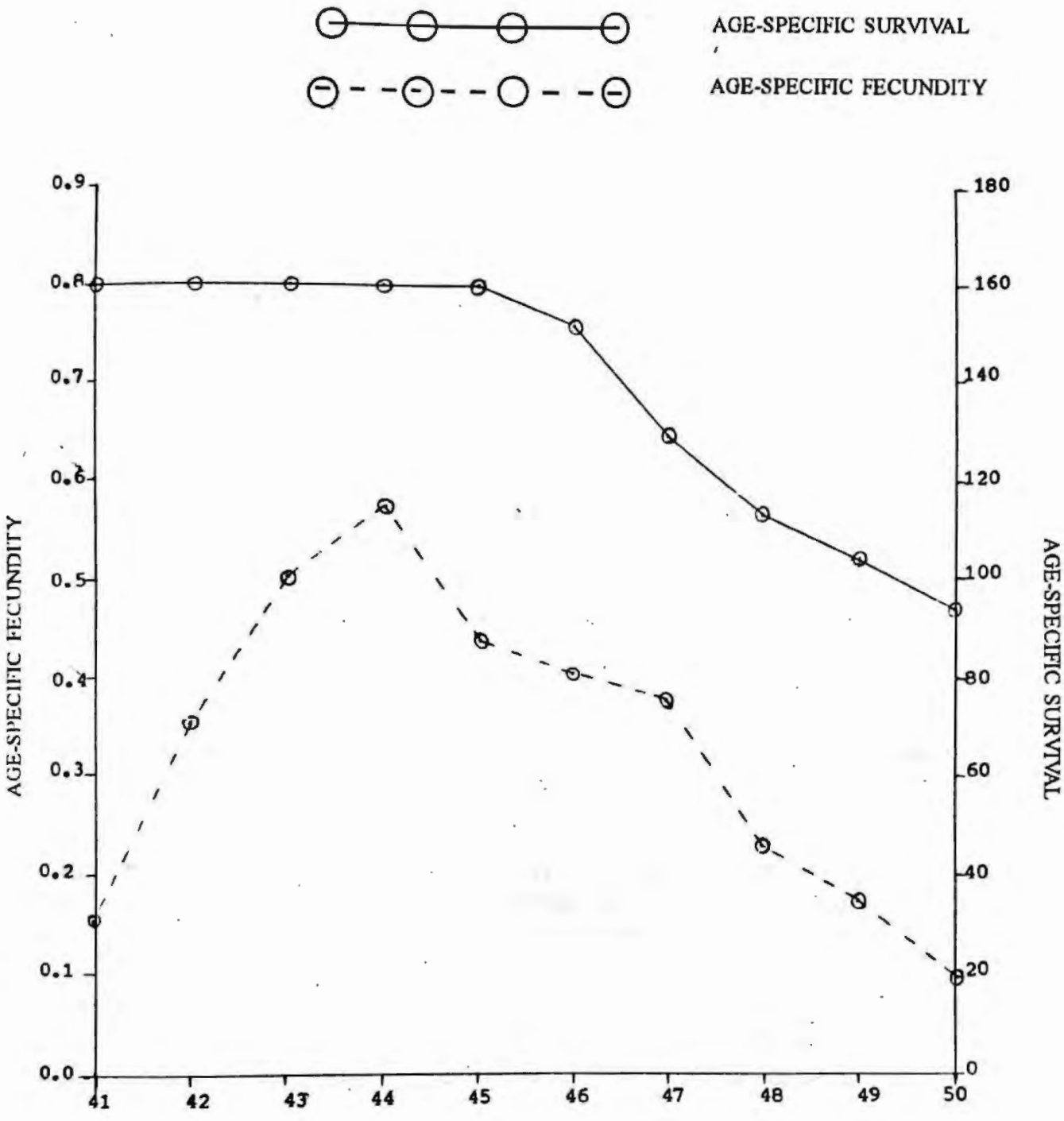

Fig. 1 : Age-specific survival and fecundity of *H. armigera* on sunflower.

TABLE 2

Life table (for females) and age-specific fecundity for *H. armigera* on sunflower.

Pivotal age in days x	*Survival of female at defferent age interval lx*	*Age schedule for female birth mx*	*lxmx*	*xlxmx*
0 - 36	0.80	—	—	Immature
37	0.80	—	0.80	29.60
38	0.80	—	0.80	30.40
39	0.80	—	0.80	31.20
40	0.80	—	0.80	32.00
41	0.80	25.20	20.16	826.56
42	0.80	71.39	57.11	2398.70
43	0.80	101.36	81.09	3486.78
44	0.80	115.13	92.10	4052.58
45	0.80	87.81	70.25	3161.16
46	0.76	81.10	61.64	2835.26
47	0.65	76.32	49.61	2331.58
48	0.57	45.76	26.08	1251.99
49	0.52	35.42	18.42	902.50
50	0.47	20.36	9.57	478.46
51	0.40	—	—	—

Σ lxmx = 489.23 Σ xlxmx = 21848.77

TABLE 3

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

Sr. No.	*Population growth statistics*	*Formula*	*Calculated values*
1.	Net reproductive rate	$Ro = \Sigma$ lxmx	489.23
2.	Mean length of generation	$Tc = \frac{\Sigma \text{ xlxmx}}{Ro}$	44.66 Days
3.	Innate capacity for increase in numbers	$rm = \frac{\log_e Ro}{Tc}$	0.1387 Females/ female/ day
4.	Arbitary 'rm' (rc)	0.13 and 0.14	
5.	Corrected 'rm'	Σ e-rmx.lxmx	0.1396 Females/ female/ day

1.	2.	3.	4.
6.	Corrected generation time	$T = \frac{\log_e Ro}{rm}$	44.36 Days
7.	Finite rate of increase in number	= untilog e^{rm}	1.150 Females/ female/ day
8.	Weekly multiplication of population	$(\lambda)^7$	2.660 Times
9.	Hypothetical F_2 females.	$(Ro)^2$	239345.99

TABLE 4

Age-specific distribution of *H. armigera* on sunflower (rm = 0.1396).

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	0.8697	0.8697	14.1100
1.	1.00	0.7564	0.7564	12.2719
2.	1.00	0.6578	0.6578	10.6722
3.	0.94	0.5721	0.5378	8.7253
				45.7794
4.	0.89	0.4976	0.4428	7.1840
5.	0.89	0.4327	0.3851	6.2479
6.	0.89	0.3764	0.3350	5.4350
7.	0.88	0.3273	0.2880	4.6725
8.	0.88	0.2847	0.2505	4.0641
9.	0.88	0.2476	0.2179	3.5352
10.	0.88	0.2153	0.1895	3.0745
11.	0.88	0.1873	0.1648	2.6737
12.	0.88	0.1629	0.1433	2.3249
13.	0.88	0.1416	0.1246	2.0215
14.	0.88	0.1232	0.1084	1.7003
15.	0.88	0.1071	0.0943	1.5299
16.	0.87	0.0932	0.0811	1.3158
17.	0.85	0.0810	0.0689	1.1178
18.	0.84	0.0704	0.0592	0.9605
19.	0.84	0.0613	0.0515	0.8355
20.	0.84	0.0533	0.0448	0.7268
21.	0.84	0.0464	0.0389	0.6311
				50.0510

1.	2.	3.	4.	5.
22.	0.84	0.0403	0.0339	0.5500
23.	0.84	0.0351	0.0295	0.4786
24.	0.84	0.0305	0.0256	0.4153
25.	0.84	0.0265	0.0223	0.3618
26.	0.84	0.0231	0.0194	0.3147
27.	0.84	0.0201	0.0169	0.2742
28.	0.84	0.0174	0.0147	0.2385
29.	0.84	0.0152	0.0127	0.2060
30.	0.84	0.0132	0.0111	0.1801
31.	0.84	0.0115	0.0096	0.1557
32.	0.84	0.0100	0.0084	0.1363
33.	0.84	0.0089	0.0073	0.1184
34.	0.84	0.0076	0.0063	0.1022
35.	0.84	0.0066	0.0055	0.0892
36.	0.84	0.0057	0.0048	0.0779
				3.6989
37.	0.82	0.0050	0.0041	0.0665
38.	0.80	0.0043	0.0035	0.0568
39.	0.80	0.0038	0.0030	0.0487
40.	0.80	0.0033	0.0026	0.0422
41.	0.80	0.0028	0.0023	0.0373
42.	0.80	0.0025	0.0020	0.0324
43.	0.80	0.0021	0.0017	0.0276
44.	0.80	0.0019	0.0015	0.0243
45.	0.80	0.0016	0.0013	0.0211
46.	0.76	0.0014	0.0011	0.0178
47.	0.65	0.0012	0.0008	0.0130
48.	0.57	0.0011	0.0006	0.0097
49.	0.52	0.0009	0.0005	0.0081
50.	0.47	0.0008	0.0004	0.0065
				0.4120

TABLE 5

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

Pivotal age (days)	*Numbers suviving to the beginning of age interval*	*Numbers dying during x*	*Mortality rate per hundred alive at begining of age interval* $\frac{(dx.100)}{lx}$	*Alive between age x and x and x + 1* $\frac{(l\,x + (l\,x + l))}{2}$	*Numbers of the individual's life days beyond x*	*Expectation of further life* $\frac{Tx}{lx} \times 2$
(x)	*(lx)*	*(dx)*	*(100 qx)*	*(Lx)*	*(Tx)*	*(ex)*
0 — 5	100	11	11.00	94.50	852.50	17.05
5 — 10	89	1	1.12	88.50	758.00	17.03
10 — 15	88	0	0.00	88.00	669.50	15.22
15 — 20	88	4	4.55	86.00	581.50	13.22
20 — 25	84	0	00.0	84.00	495.50	11.80
25 — 30	84	0	0.00	84.00	411.50	9.80
30 — 35	84	0	0.00	84.00	327.50	7.80
35 — 40	84	4	4.76	80.00	243.50	5.80
40 — 45	80	0	0.00	80.00	163.50	4.09
45 — 50	80	33	41.25	63.50	83.50	2.09
50 — 55	47	7	14.89	20.00	20.00	0.85

fecundity and of egg laying. The net reproductive rate (Ro) represnting the total female births was 489.23 indicating that the population would multiply 489.23 times at the end of every generation.

The data on intrinsic rate of *H. armigera* (Table 3), indicated that the innate capacity for increase in number (rm) was 0.1396 females per female per day with a daily finite rate of increase (λ) 1.150 females per female per day. Thus, the population would be able to multiply 2.660 times per week. The mean length of generation (T) was worked out 44.36 days for the cohort.

On reaching the stable age distributio (Table 4) the eggs, larvae, pupae and adu contributed to the tune of 45.78, 50.05, 3.7 and 0.41 per cent, respectively to th population. The life expectancy tables wa constructed and the results are presented Table 5. The life expectancy (ex) of new deposited eggs was only 17.05 days. Th mortality rate was very high up to the pivot age of 5 days. Almost similar observations o sunflower for different parameters of life table were also reported by Bilapate *et al.*, 198 Thus, the present findings are in clos conformity of the earlier reports.

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