GAU Res. J. 1998. 23 (2) : 45-53

Life Table of Gram Podborer, *Helicoverpa armigera* (Hubner) on Lucerne*

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ABSTRACT

Studies on the intrinsic rate of multiplication of *Helicoverpa armigera* (Hubner) were carried out at a constant temperature of 26 + 1 °C on lucerne. The maximum duration of egg, larva and pupa were observed 3, 17 and 15 days, respectively. The net reproductive rate (Ro) representing the total female births was 206.35. The population increased with an infinitesimal rate (rm) of 0.1272 and finite rate (λ) 1.136 females per female per day. The mean generation time (TC) was 42.34 days. It was estimated that on reaching stable age distribution, the population of *H. armigera* would comprise 41.34 per cent eggs, 52.67 per cent larvae, 5.37 per cent pupae and 0.63 per cent adults. The expectation of further life at the age interval of 10 to 15 days was reduced to 13.29 days from 16.54 days in the beginning.

(Received on 2nd Aug., 1987)

INTRODUCTION

The gram podborer, *Helicoverpa armigera* (Hubner) Hardwick is a polyphagous pest causing severe damage to many cultivated crops. Life table is a concise summary of certain vital statistics of insect population. It is a useful technique in the study of population dynamics and provides a formate for recording and accounting for all population changes in the life cycle of a species in its natural environment. The present paper deals with the rate of multiplication in the population of *H. armigera* on lucerne.

The pest survive on lucerne during summer season in Gujarat and information is lacking on population buildup of this pest in next generation when reared on lucerne therefore, present study was undertaken.

MATERIALS AND METHODS

In order to construct the facundity life-table of females, laboratory culture of *H. armigera* reared on lucerne for two consecutive generations at a constant temperature of 26 + 1°C., Five adult pairs were released for egg laying in 45 x 45 x 60 cm wooden cages. Eggs laid on white muslin cloth were collected by wet camel hair brush and 100 eggs were kept for hatching in the batches of 10 each. Immediately after hatching, the

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larvae were transferred on lucerne leaves kept in plastic containers (5.0 x 5.5 cm). Fresh food was provided daily in the morning. Observations on hatching, larval development, formation of purpae, successful adult emergence and fecundity were recorded daily which provide the values for the life-table (1x). Age specific mortality in different developmental stages like eggs, larvae, pupae and adults were recorded. With a view to determine the age specific facundity of females, total number of adults emerged on the same day were caged for oviposition. The fecundity of the females on subsequent days were noted 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 (1948). Howe (1953) and Atwal and Bains (1974). Stable age distribution (per cent distribution of various stages) was worked out by observing the population schedule of birth rate and death rate (mx and lx) when grown in limited space. Life expectancy was computed by using the method reported by Deevey (1947) and Atwal and Bains (1974).

RESULTS AND DISCUSSION

The maximum duration of egg, larva and pupa were recorded 3, 17 and 15 days, respectively. The number that survived from egg to adult emergence was 78 individuals (Table 1). The data on life fecundity and age specific fecundity are presented in Table-2 and Fig. 1. It is evident from the data that first female mortality occurred on 9th day after emergence which increased on subsequent days. The net reproductive rate which

TABLE 1

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

No. of eggs	*Numbers survived*		
	Egg stage (0 to 3 days)	*Larval stage (4 to 20 days)*	*Pupal stage (21 to 35 days)*
10	10	9	8
10	10	9	8
10	10	8	7
10	10	9	8
10	10	9	8
10	10	9	8
10	10	9	8
10	10	9	8
10	10	8	7
10	10	9	8
100	100	88	78

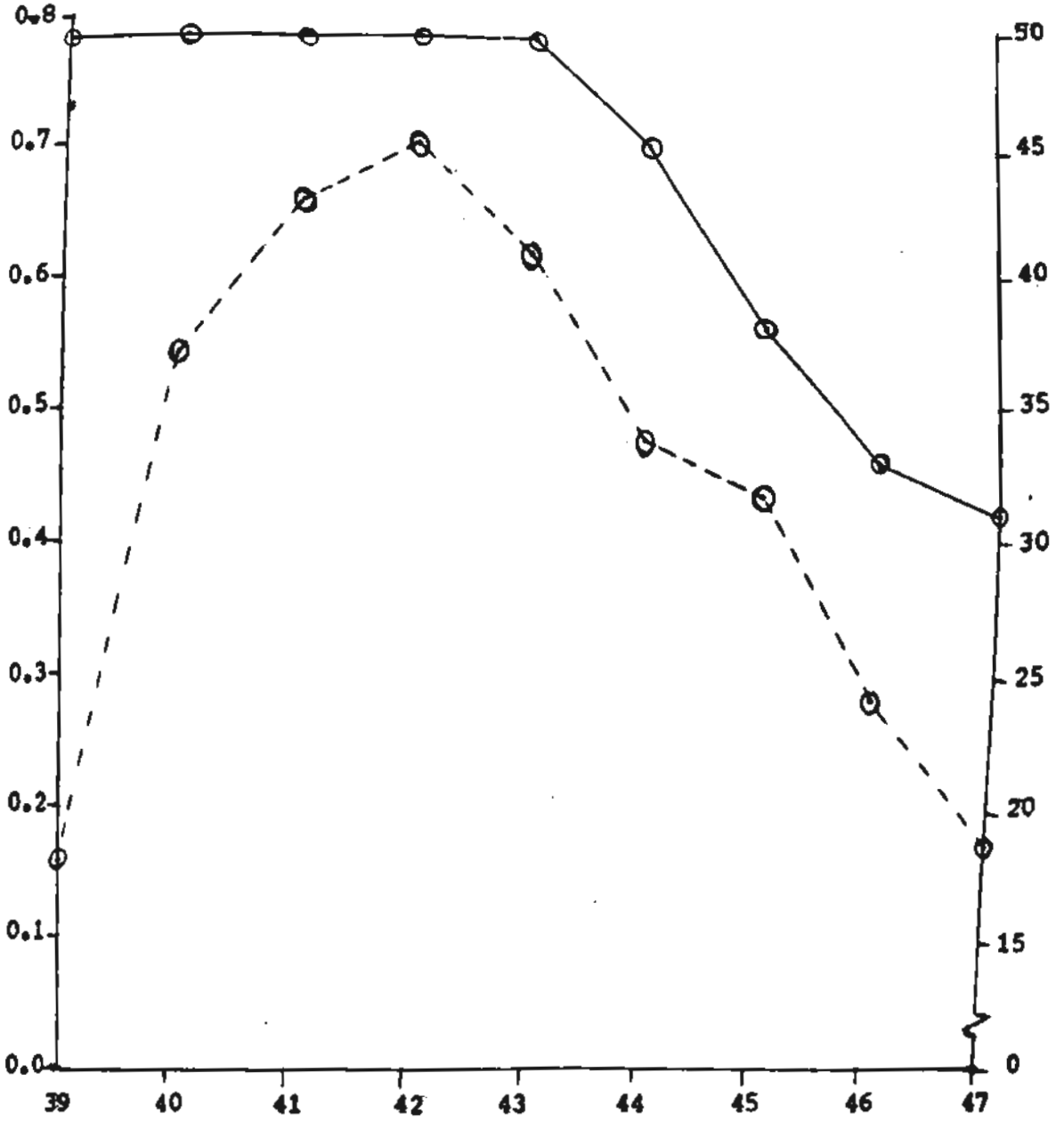


Fig. 1 : Daily age-specific survival and fecundity of *H. armigera* on lucerne.

TABLE 2

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

Pivotal age in days x	*Survival of female at different age interval* lx	*Age schedule for female birth* mx	lxmx	xlxmx
0 – 35	0.78	–	–	Immature
36	0.78	–	0.78	28.08
37	0.78	–	0.78	28.86
38	0.78	–	0.78	29.64
39	0.78	18.00	14.08	547.56
40	0.78	37.37	29.15	1165.94
41	0.78	42.69	33.30	1365.23
42	0.78	45.09	35.17	1477.15
43	0.78	40.89	31.89	1371.45
44	0.70	33.85	23.70	1042.58
45	0.56	31.72	17.76	799.34
46	0.46	24.17	11.12	511.52
47	0.42	18.75	7.88	370.13
48	0.40	0.00	0.00	0.00

$\sum$ lxmx = 206.35 $\sum$ xlxmx = 8737.48

indicates total female births per generation was recorded to the tune of 206.35. The oviposition period lasted for 9th days and reached a peak (mx = 45.09 females per female per day) on the 42nd day of pivotal age and then declined slowly.

The mean time required to complete the generation (TC) was 41.90 days (Table-3). The innate capacity (rm) and finite rate (λ) for increase in numbers was calculated 0.1259 and 1.136 females per female per day, respectively. The population was capable to multiply 2.436 times per week. The hypothetical female population in F_2 generation was 42733.16.

TABLE 3

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

Sr. No.	*Population growth statistics*	*Formula*	*Calculated values*
1.	Net reproductive rate	$Ro = \sum lxmx$	206.35
2.	Mean length of generation	$TC = \frac{\sum x lxmx}{Ro}$	42.34 days
3.	Innate capacity for increase in numbers	$rm = \frac{\log_e Ro}{TC}$	0.1259 Females/ female/day
4.	Arbitarary 'rm' (rc)	0.12 and 0.13	
5.	Corrected 'rm'	$\sum e^{7-rmx} lxmx$	0.1272 Females/ female/ day
6.	Corrected generation time	$T = \frac{\log_e Ro}{rm}$	41.90 days
7.	Finite rate of increase in number	$= \text{antilig } e^{rm}$	1.136 Females/ female/ day
8.	Weekly multiplication of population	$(\lambda)7$	2.436 Times
9.	Hypothetical F_2	$(Ro)^7$	42733.16

The contribution of different developmental stages towards the stable age-distribution was determined and results obtained are presented in Table-4. It is seen that on reaching the stable age-distribution, the population in its various stages viz., egg, larva, pupa and adult contributed to the tune of 41.34, 52.67, 5.37 and 0.63 per cent, respectively.

The data on life expectancy (Table-5) indicated that the life expectancy of newly deposited eggs was only 16.54 days. The mortality rate was comparatively high at the age of 10 to 15 days, when the expectancy of life was reduced to 13.29 days from 16.54 days in the beginning.

TABLE 4

Age-specific distribution of *H. armigera* on lucerne (rm = 0.1272).

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	0.8806	0.8806	12.3822
1	1.00	0.7754	0.7754	10.9030
2	1.00	0.6828	0.6828	9.6009
3	1.00	0.6012	0.6012	8.4536
				41.3397
4	1.00	0.5294	0.5294	7.4440
5	0.99	0.4662	0.4615	6.4892
6	0.98	0.4105	0.4023	5.6568
7	0.98	0.3615	0.3542	4.9805
8	0.96	0.3183	0.3056	4.2971
9	0.95	0.2803	0.2663	3.7445
10	0.95	0.2468	0.2345	3.2973
11	0.95	0.2173	0.2064	2.9022
12	0.95	0.1914	0.1818	2.5563
13	0.93	0.1685	0.1567	2.2033
14	0.90	0.1484	0.1335	1.8772
15	0.88	0.1307	0.1150	1.6170
16	0.88	0.1150	0.1012	1.4230
17	0.88	0.1013	0.0891	1.2528
18	0.88	0.0892	0.0785	1.1038
19	0.88	0.0785	0.0691	0.9716
20	0.88	0.0692	0.0609	0.8563
				52.6729
21	0.88	0.0609	0.0536	0.7537

1.	2.	3.	4.	5.
22	0.88	0.0536	0.0472	0.6637
23	0.88	0.0472	0.0416	0.5849
24	0.88	0.0416	0.0366	0.5146
25	0.88	0.0366	0.0322	0.4528
26	0.88	0.0322	0.0284	0.3993
27	0.88	0.0284	0.0250	0.3515
28	0.88	0.0250	0.0220	0.3093
29	0.88	0.0220	0.0194	0.2728
30	0.88	0.0192	0.0171	0.2404
31	0.88	0.0171	0.0150	0.2109
32	0.88	0.0150	0.0132	0.1856
33	0.88	0.0132	0.0116	0.1631
34	0.88	0.0117	0.0103	0.1448
35	0.83	0.0103	0.0085	0.1195
				5.3669
36	0.78	0.0090	0.0070	0.0984
37	0.78	0.0080	0.0062	0.0872
38	0.78	0.0070	0.0055	0.0773
39	0.78	0.0062	0.0048	0.0675
40	0.78	0.0054	0.0042	0.0591
41	0.78	0.0048	0.0038	0.0534
42	0.78	0.0042	0.0033	0.0464
43	0.78	0.0037	0.0029	0.0408
44	0.70	0.0033	0.0023	0.0323
45	0.56	0.0029	0.0016	0.0225
46	0.46	0.0025	0.0012	0.0169
47	0.42	0.0022	0.0009	0.0127
48	0.40	0.0020	0.0008	0.0112
				0.6257

TABLE 5

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

Pivotal age (days) (x)	Numbers surviving to the beginning of age interval (lx)	Number dying during x (dx)	Mortality rate per hundred alive at beginning of age interval $\frac{(dx.100)}{lx}$ (100 qx)	Alive between age x and x + 1 $\frac{l\,x + (l\,x + 1)}{2}$ (Lx)	Numbers of the individual's life days beyond x (Tx)	Expectation of further life $\frac{Tx}{lX} \times 2$ (ex)
0 — 5	100	2	2.00	99.00	827.00	16.54
5 — 10	98	3	3.06	96.50	728.00	14.86
10 — 15	95	7	7.37	91.50	631.50	13.29
15 — 20	88	0	0.00	88.00	540.00	12.27
20 — 25	88	0	0.00	88.00	452.00	10.27
25 — 30	88	0	0.00	88.00	364.00	8.27
30 — 35	88	0	0.00	83.00	276.00	6.27
35 — 40	78	10	12.82	78.00	193.00	4.95
40 — 45	78	22	28.21	67.00	115.00	2.95
45 — 50	56	16	28.57	48.00	48.00	1.71

Similar type of life table studies of *H. armigera* have been computed on lucerne and it was found that net reproductive rate was 185.69, whereas mean length of generation was 46.12 days. The innate capacity for increase in numbers and finite rate of increase were 0.1132 and 1.12 females per female per days (Bilapate *et al.* 1977). These observations are more or less similar to the present findings.

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