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Life table of bud borer, *Anarsia achrasella* Bradley on sapota

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ABSTRACT

Studies on innate capacity for increase of *Anarsia achrasella* Bradley on sapota were carriedout under laboratory condition at a constant temperature of 26 ± 1 °C during the Month of April, 2008 to August, 2008 at Anand Agricultural University, Anand. The maximum duration of egg, larva and pupa were recorded 4, 9 and 8 day, respectively. The net reproductive rate (Ro) 10.32 was obtained with a mean length of generation (T) 25.39 day. Intrinsic rate of natural increase in number (rm) was 0.091 female per female per day. The life expectancy of newly deposited eggs was 5.98 days. The expectancy of further life was 5.98 day at the time of adult emergence. The contribution of egg to stable age distribution was 44.82 per cent, whereas it was 37.70 per cent by larval stage. Contribution of pupal and adult stage was negligible as it found 12.95 and 4.55 per cent, respectively.

Key words : Life table, sapota

Sapota tree is attacked by more than 25 insect pests (Butani, 1979). Among them, chiku bud borer, Anarsia achrasella Bradley is a regularly occurring insect pest of sapota trees in middle Gujarat. The larvae attack the flower buds resulting in a considerable flowers dropping. In view of its economic importance, a detailed study on life table was undertaken under constant laboratory temperature. Life fecundity tables are useful in determining the valuable stage in the life cycle of the pest, which contributes to the trend of population. For determining the reproductive ability and biotic potential, statistic was developed to explain population increase (Birch, 1948 and Howe, 1953).

MATERIALS AND METHODS

The culture of *A. achrasella* was maintained on twigs of sapota for two consecutive generation at constant temperature of 26 ± 1 °C using B.O.D. incubator under laboratory. The adults obtained from the laboratory culture were used for further study. The male and female moth pairs were kept for egg laying in wooden cage (30 cm × 30 cm × 45 cm) having shoots of sapota. Eggs laid on buds were used for this study. In order to construct life table, freshly laid 100 egg were collected from the cage with the help of wet camel hair brush and placed in ten Petri dish in batches of 10 each. The eggs were glued on slides in one row to facilitate observation on hatching. At the time of hatching, the larvae were transferred individually into plastic vials containing flower bud. Fresh bud was provided daily in the morning. Observations on hatching, larval development, formation of pupae and successful emergence of adult and fecundity were recorded daily. Age specific mortality in different developmental stages like egg, larva, pupa and adult were also recorded. With a view to determine the age specific fecundity, total number of adults emerged on the same day were further kept in wooden cage for oviposition. Fresh bouquet of sapota containing bud was used for oviposition. The eggs laid on the buds were

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recorded. Observations on fecundity were taken till the death of the females. The column headings for the construction of life fecundity tables proposed by Howe (1953) and Atwal and Bains (1974) were used in this study.

RESULTS AND DISCUSSION

The results indicated that there was five per cent mortality during egg stage. The number that survived from 100 egg to adult emergence was 72 individuals. The maximum duration of egg, larva and pupa were recorded as 4, 9 and 8 days, respectively (Table 1). Life fecundity table was constructed to determine the survival of female (lx) and age specific fecundity (mx). Close perusal of the data (Table 2) indicated that pre-oviposition period was 21st days of pivotal age. Female started laying eggs at 22nd day and stopped it at 32nd day, with lx values being 0.72 and 0.04, respectively. The females contributed the highest number of progeny (mx=3.92) on 28th day of pivotal age which decreased day by day.

The net reproductive rate (Ro) 10.32 was obtained with a mean length of generation (T) 25.39 days, intrinsic rate of natural increase in number (rm) and finate rate of natural increase in number (λ) as 0.091 females per female per day and 1.0958, respectively. The population would be able to multiply 1.89 time per week. The hypothetical F2 females were worked out to be 106.50 (Table 3). Solanki (2007) calculated the mean length of generation time of S. litura was 42.61 and 45.52 day on castor and lucerne, respectively. The intrinsic rate of natural increase in number (rm) was 0.171 and 0.149 female per female on castor and lucerne, respectively. According to Gedia et al. (2008), the mean generation time (T) of S. litura on groundnut was 35.67 day. The intrinsic rate of increase in numbers (rm) and finate rate of natural increase in number (λ) as 0.1748 and 1.1910 female per female per day, respectively. The net reproductive rate (Ro) of P. xypostella on cabbage of 95.33 was obtained with mean length of generation (T) 27.45 days. The intrinsic rate of natural increase in numbers (rm) was 0.1635 female per female per day (Dabhi *et al.*, 2009). Singh and Yadav (2009) reported that the rate of multiplication of *Helicoverpa armigera* (Hub.) on chickpea pod with an intrinsic rate of natural increase in number (rm) was 13.54 female per female per day within finate rate of increase of increase in number (λ) 1.1459 female per female per day. The data showed that the adults contributed only 4.55 per cent to the population of stable age and that of eggs, larvae and pupae was 44.82, 37.70 and 12.95 per cent, respectively (Table 4).

Table 1 Survival of different life stages of *Anarsia achrasella* during development on sapota buds

No. of eggs	Survived number of stage		
	Egg (0–4 days)	Larval (5–13 days)	Pupal (14–21 days)
10	10	8	8
10	9	8	8
10	9	8	8
10	10	7	7
10	10	7	7
10	10	9	9
10	9	7	6
10	9	7	7
10	10	8	8
10	9	7	7
100	95	73	72

The life expectancy of *A. achrasella* declined gradually with the advancement of development (Table 5). The life expectancy of newly deposited eggs was 5.98 day. The expectancy of further life was 5.98 day at the time of adult emergence. Life expectancy of newly deposited eggs of S. litura was 15.26 day on lucerne and 15.45 day on castor as reported by Solanki (2007). According to Dabhi *et al.*, (2009), the life expectancy of newly deposited eggs of P. xypostella on cabbage was 12.82 days. The contribution of egg to stable age distribution was 44.82 per cent, whereas it was 37.70 per cent by larval stage. Contribution of pupal and adult stage was negligible as it found 12.95 and 4.55 per cent, respectively.

Among the various immature stages, eggs and larvae contributed the highest on reaching stable age distribution of the S. litura on castor and lucerne as reported by Solanki (2007). Singh and Yadav (2008) revealed that age distribution of *H. armigera*

Table 2 Life table (for female) and age specific fecundity for *A. achrasella* on sapota buds

Pivotal age in days (x)	Survival of female at different age intervals (lx)	Age schedule for female births (mx)	lxmx	Xlxmx
0-20	Immature stages			
21	Pre-oviposition stage	1.50	1.08	23.76
22	0.72	1.69	1.17	26.82
23	0.69	1.95	1.23	29.48
24	0.63	2.82	1.58	39.48
25	0.56	3.38	1.55	40.42
26	0.46	3.49	1.29	34.87
27	0.37	3.92	1.06	29.64
28	0.27	3.50	0.67	19.29
29	0.19	3.41	0.41	12.28
30	0.12	2.87	0.23	7.12
31	0.08	1.50	0.06	1.92
32	0.04		$\sum$lxmx = 10.32	$\sum$xlxmx = 265.07

Table 3 Length of generation, innate capacity and finite rate of increase in numbers of *A. achrasella* on sapota buds

Population growth statistics	Formula	Calculated value
Net reproductive rate	$Ro = \sum lxmx$	10.32
Mean length of generation	$Tc = \frac{\sum xlxmx}{Ro}$	25.39 days
Innate capacity for increase in numbers	$rm = \frac{\log e Ro}{Tc}$	0.091 females/female/day
Arbitrary 'rm' (rc)	0.09 and 0.10	-
Corrected 'rm'	$\sum e^{7- rmx.\ lxmx}$	0.0915 females/female/day
Corrected generation time	$T = \frac{\log e Ro}{rm}$	25.39days
Finite rate of increase in numbers	$(\lambda) = \text{antilog } e^{rm}$	1.0958 females/female/day
Weekly multiplication of population	$(\lambda)^7$	1.8971
Hypothetical F_2 females	$(Ro)^2$	106.5024

Table 4 Age specific distribution of *A. achrasella* on sapota buds (rm = 0.0915)

Pivotal age in days 'x'	Lx	$e^{-rm(x+1)}$	Lx. $e^{-rm(x+1)}$	Percentage distribution
0	1.00	0.9121	0.9121	10.8545
1	1.00	0.8319	0.8319	9.9001
2	0.99	0.7588	0.7512	8.9397
3	0.97	0.6921	0.6714	7.9900
4	0.95	0.6313	0.5997	7.1368
				44.8211
5	0.95	0.5758	0.5470	6.5096
6	0.95	0.5252	0.4989	5.9372
7	0.92	0.4790	0.4407	5.2446
8	0.90	0.4369	0.3932	4.6793
9	0.83	0.3985	0.3308	3.9367
10	0.79	0.3635	0.2872	3.4178
11	0.75	0.3315	0.2487	2.9596
12	0.73	0.3024	0.2208	2.6276
13	0.73	0.2758	0.2014	2.3967
				37.7091
14	0.73	0.2516	0.1837	2.1861
15	0.73	0.2295	0.1675	1.9933
16	0.73	0.2093	0.1528	1.8184
17	0.73	0.1909	0.1394	1.6589
18	0.73	0.1741	0.1271	1.5125
19	0.72	0.1588	0.1144	1.3614
20	0.72	0.1449	0.1043	1.2412
21	0.72	0.1321	0.0951	1.1789
				12.9507
22	0.72	0.1205	0.0863	1.0270
23	0.69	0.1099	0.0758	0.9020
24	0.63	0.1003	0.0632	0.7521
25	0.52	0.0915	0.0476	0.5664
26	0.46	0.0834	0.0384	0.4569
27	0.37	0.0761	0.0281	0.3344
28	0.27	0.0694	0.0187	0.2225
29	0.19	0.0633	0.0120	0.1428
30	0.12	0.0557	0.0069	0.0821
31	0.08	0.0527	0.0042	0.0499
32	0.04	0.0480	0.0019	0.0226
			8.4029	**4.5587**

Table 5 Life table for computing life expectancy of A. achrasella reared on sapota buds

Pivotal age in days	Number surviving to the beginning of age interval	Number dying during 'x'	Mortality rate/100 alive at beginning of age interval $\frac{dx.100}{lx}$	Alive between age 'x' and 'x + 1' $\frac{lx + (lx + 1)}{2}$	No. of 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	21	21.00	100.50	299.00	5.98
5-10	79	06	7.59	79.50	219.50	5.56
10-15	73	01	1.37	73.50	146.00	4.00
15-20	72	16	22.22	72.50	73.50	2.04
20-25	52	26	50.00	52.50	17.00	0.61
25-30	12	03	25.00	12.50	4.50	0.75
30-35	04	00	0.00	4.50	0.00	0.00

on chickpea manifested that eggs and larvae contributed the highest to the population of stable age, whereas the contribution of pupa and adults was negligible. Dabhi et al. (2009) concluded that on reaching the stable age distribution of P. xylostella on cabbage, the eggs, larvae, pupae and adults contributed to the tune of 56.86, 37.71, 4.27 and 1.44 per cent, respectively. Similarly, Gedia et al. (2008) showed that the per cent contribution of eggs, larvae, pupae and adults were 52.00, 46.4, 1.30 and 0.30 per cent, respectively.

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