

LIFE TABLE STUDIES OF *APHIS GOSSYPHII* GLOVER (HOMOPTERA : APHIDIDAE) ON BRINJAL

M.A. SATTAR SHAH, T.K. SINGH* AND R.K. RADHAKRISHORE**

DEPARTMENT OF ZOOLOGY, Y.K. COLLEGE, WANGJING-795 148, INDIA..

DEPARTMENT OF LIFE SCIENCES, MANIPUR UNIVERSITY,
IMPHAL-795 003, INDIA*.

DEPARTMENT OF ZOOLOGY, MANIPUR COLLEGE,
IMPHAL-795 003, INDIA**

(e-mail: tksingh06@yahoo.co.in)

Life table studies of *Aphis gossypii* Glover infesting brinjal was conducted in the laboratory. The net reproductive rate (R_0) was worked out as 29.225 females/female/generation. The mean length of generation time (T) was 9.5482 days. The intrinsic rate of increase (r_m) and finite rate of increase (λ) were worked out as 0.35347 and 1.4240 females/female/day respectively. On reaching the stable age distribution, the population comprised mainly of nymphs. In addition, the life expectancy (e_x) of *A. gossypii* was found to decline gradually with the advancement of age.

Key words : *Aphis gossypii*, brinjal, Life table.

INTRODUCTION

The cotton aphid, *Aphis gossypii* Glover is a cosmopolitan polyphagous pest attacking large number of crops. It is considered as the major pest of brinjal (Butani & Verma, 1976). Heavy infestation of this pest results in deformation, leaf curling and drying and stunted growth of the plant and reduces the yields. In addition, it is capable of transmitting more than 50 plants viruses (Biswas *et. al.*, 2004). The study of life table of a pest provides the growth rate statistics which can be used as a predictive basis for the control of the pest. Hence, the present investigation is undertaken to understand the rate of multiplication, stable age distribution and life expectancy of *A. gossypii* on brinjal in the agroclimatic conditions of Manipur.

MATERIALS AND METHODS

The life table studies of *A. gossypii* on brinjal *var.* Pusa purple long was conducted in the laboratory of Life Sciences Department, Manipur University, Imphal during August-September, 2007. Large numbers of adult apterous parthenogenetic viviparous females collected from the field from the host plant and laboratory stock culture was also maintained. Seven freshly laid first instar nymphs were obtained from the stock culture and transferred individually to separate petridishes (9 x 1.5cm). Tender leaves of the host plant were provided as food for the aphid. Thus, seven replications were kept separately on the host plant and observation on the survival of each individual nymph till its natural death was recorded daily. Using the data on survival, fecundity and life span, life table was constructed according to the method of Birch (1948) and Southwood (1978).

RESULTS AND DISCUSSION

The study revealed that the aphid attained maturity within 6 days on the host plant. Hence, parthenogenetic viviparous apterous aphid started producing nymphs after 6th day of pivotal age which lasted upto 17th day and 'lx' value being 1.0 and 0.30, respectively

Table I : Life and age specific fecundity table of *A. gossypii* on brinjal.

Pivotal Age (days) (x)	Survival of female at different age interval (l_x)	Age specific fecundity (m_x)	$l_x m_x$	$x l_x m_x$	Trial r_m ($e^{7-r_m} x l_x m_x$)		Accurate r_m
					0.323	0.329	
0-6	Immature stage (developmental and pre-reproductive)						
7	1.00	2.857	2.86	19.10	326.6	313.18	263.8767
8	1.00	4.142	4.14	33.14	342.8	326.74	268.6525
9	1.00	5.000	5.00	45.00	299.6	283.85	227.7407
10	1.00	4.714	4.71	47.14	204.7	192.58	150.7823
11	1.00	4.000	4.00	44.00	125.6	117.60	89.8484
12	0.86	4.000	3.44	41.28	78.22	72.78	54.2624
13	0.72	2.571	1.85	24.06	30.47	28.18	20.5039
14	0.58	2.857	1.66	23.20	19.75	18.16	12.8897
15	0.58	1.714	0.99	14.19	8.58	7.84	5.4299
16	0.30	1.571	0.47	7.536	2.94	2.67	1.8068
17	0.30	0.429	0.13	2.193	0.58	0.53	0.3475
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Σ		33.855	29.3	302.5	1440.	1364.11	1096.141

Table II : Population growth parameters of *A. gossypii* on brinjal

S.No.	Parameters	Formula	Calculated value
1.	Net reproductive rate (R_0)	$\Sigma l_x m_x$	29.225
2.	Approximate generation time (T_c)	$\Sigma x l_x m_x / R_0$	10.349
3.	Estimated value of intrinsic rate of increase in number (r_c)	$\log_e R_0 / T_c$	0.326
4.	Arbitrary r_m		0.323 & 0.329
5.	Intrinsic rate of increase (r_m)	$e^{7-r_m} x l_x m_x = 1096.6$	0.35347
6.	True generation time (T)	$\log_e R_0 / r_m$	9.5482
7.	Finite rate of increase in number (λ)	$\text{antilog}_e r_m$	1.4240
8.	Doubling time (DT)	$\log_e 2 / r_m$	1.9609
9.	Rate of weekly multiplication of the population (RWM)	$\text{antilog}_e r_m^7$	11.8732
10.	Rate of increase per crop season (4 months) (CSRI)	$\text{antilog}_e r_m^{120}$	2.6376×10^{18}
11.	Rate of increase per crop season (10 months) (CSRI)	$\text{antilog}_e r_m^{300}$	1.1299×10^{46}
12.	Annual rate of increase (ARI)	$\text{antilog}_e r_m^{365}$	1.0744×10^{56}
13.	Potential fecundity (PF)	Σm_x	33.855
14.	Hypothetical female in F_2 generation (Ro) ²	$(\Sigma l_x m_x)^2$	854.1006

Table III : Stable age distribution of *A. gossypii* on brinjal

Pivotal age in days (X)	l_x	L_x	$e^{-rm}(X+1)$	$L_x \cdot e^{-rm}(X+1)$	% distribution $100\beta L_x \cdot e^{-rm}(X+1)$	
0	1	1	0.7022	0.7022	29.99	Nymph 92.23
1	1	1	0.4932	0.4932	21.06	
2	1	1	0.3463	0.3463	14.79	
3	1	1	0.2432	0.2432	10.39	
4	1	1	0.1708	0.1708	7.29	
5	1	1	0.1199	0.1199	5.12	
6	1	1	0.0842	0.0842	3.59	
7	1	1	0.0591	0.0591	2.52	Apterous adult 7.77
8	1	1	0.0415	0.0415	1.77	
9	1	1	0.0292	0.0292	1.25	
10	1	1	0.0205	0.0205	0.88	
11	1	0.930	0.0144	0.0134	0.57	
12	0.86	0.790	0.0101	0.0079	0.34	
13	0.72	0.650	0.0070	0.0046	0.19	
14	0.58	0.580	0.0049	0.0028	0.12	
15	0.58	0.440	0.0035	0.0015	0.06	
16	0.30	0.300	0.0025	0.0008	0.03	
17	0.30	0.150	0.0017	0.0003	0.01	
18	0.00	0.000	0.0012	0.0000	0.00	

(Table I). The maximum laying of nymphs was recorded on 9th day of pivotal age. The maximum longevity of the reproductive female was 12 days. The net reproductive rate (R_0) was 29.225 females/female/generation (Table II). This value for *A. gossypii* is higher from the value obtained by Shah *et.al.* (2007) on okra. But the value was lower than those of other aphid species studied by Indu & Chatterjee (2006), Badjena & Mandal (2005). The approximate generation time (T_c) and true generation time (T) were 10.349 and 9.5482 days, respectively. These values of T and T_c for *A. gossypii* are lower than the values obtained by Singh *et.al.* (1993) and Shah *et.al.* (2007) on bottle gourd and okra respectively. The innate capacity for increase in number (γ_c) was 0.326, females/female/day while the true intrinsic rate of increase (γ_m) was calculated as 0.35347 females/female/day. The value of γ_c was slightly less than the value of γ_m indicating that the population was tending towards overlapping generation (Southwood, 1978). The

Table IV : Life expectancy of *A. gossypii* on brinjal.

Pivotal age (days) (x)	Nos. surviving to the beginning of age interval (lx)	Nos. dying during X (dx)	Mortality rate per 100 alive at beginning of age interval (dx.100)/lx (100qx)	Alive between age X & X + 1 $lx+(lx+1)/2$	No. of individuals life days beyond X (Tx)	Expectation of further life $Tx/lx \times 2$ (e_x)
0-2	7	0.00	0.00	7	50.5	14.43
2-4	7	0.00	0.00	7	43.5	12.43
4-6	7	0.00	0.00	7	36.5	10.43
6-8	7	0.00	0.00	7	29.5	8.43
8-10	7	0.00	0.00	7	22.5	6.43
10-12	7	1	14.29	6.5	15.5	4.43
12-14	6	2	33.33	5.0	9.0	3.00
14-16	4	2	50.00	3.0	4.0	2.00
16-18	2	2	100.00	1.0	1.0	0.00

daily finite rate of increase (λ) was 1.4240 females/female/day which could double in number every 1.9609 days. The weekly and annually multiplication rates were 11.8732 and 1.0744×10^{56} times respectively. The hypothetical female in F2 generation was 854.1006 females/female/generation.

On reaching the stable age distribution, the population of *A. gossypii* at various stages of nymph and adult were 92.23 and 7.77% respectively (Table II). The maximum contribution towards the stable age distribution was made by nymphal stage. The present finding is in conformity with those of Bijaya *et al.* (2002), Shevale (2003) and Shah *et al.* (2007).

The life expectancy of *A. gossypii* declined gradually with the advancement of age. For instance, life expectancy of newly laid nymphs was 14.43 days while it was 10.43 days at the time of maturity and 2.00 days on cessation (Table IV) Bijaya *et al.* (2002) and Shah *et al.* (2007) also reported the similar descending trends.

ACKNOWLEDGEMENT

The authors are thankful to the Head, Department of Life Sciences, Manipur University for providing laboratory facilities.

REFERENCES

- BADJENA, T. & MANDAL, S.M.A. 2005. Seasonal incidence of major insect pests and predators in cauliflower. *Ann Pl. Protect. Sci.* **13** : 472-473.
- BIJAYA, P, DEVJANI, P. & SINGH, T.K. 2002. Life table, stable age distribution and life expectancy of *Myzus persicae*(Sulzer) on cauliflower. *Shaspa*. **9**(2) : 143)-148.
- BIRCH, L.C. 1948. The intrinsic rate of increase of an insect population. *Journal of Animal Ecology*. **17** : 15-26.
- BISWAS, M.K., DE. P.K., NATH, P.S. & MOHASIN, M. 2004. Influence of different weather factors on the population build up of vectors of potato virus. *Ann Pl. Protect. Sci.* **12** : 352-355.
- BUTANI, D.K. & VERMA, S. 1976. Pest of vegetables and their control : Brinjal.. *Pest*. **10**(2) : 32-35.
- INDU & CHATERJEE, V.C. 2006. Studies on the lifecycle of the lady beetle, *Coccinella septempunctata*. *Ann. Pl. Protect. Sci.* **14** : 102-107.
- SHAH, M.A.S., SINGH, T.K. & CHHETRY, G.K.N. 2007. Life table, stable age distribution and life expectancy of *Aphis gossypii* Glover on okra .*Ann. Pl. Protect. Sci* **15**(1) : 57-60.
- SHEVALE, B.S. 2003. Studies on life fecundity table of pomegranate butterfly. *Ann. Pl. Protect. Sci.* **11** : 255-257.
- SINGH, B., GOEL, S.C. & KUMAR, S. 1993. Life table and growth rate studies of *Aphis gossypii* (Glo.) (Homoptera). *Uttar Pradesh J Zool.* **13**(1) : 21-24.
- SOUTHWOOD, T.R.E. 1978. *Ecological methods with particular reference to the study of insect population*. 1st ed., The English Language Book Society, Chapman and Hall, London, pp. 524.