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Biology and life table studies of *Acanthaspis pedestris* Stål (Heteroptera: Reduviidae) population on three lepidopteran insect pest

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ABSTRACT: The life table and intrinsic rate of increase of *Acanthaspis pedestris* Stål (Heteroptera: Reduviidae) a predator of lepidopteran insect pests *viz*., *Spodoptera litura* (Fabricius), *Earias vittella* (Fabricius) and *Corcyra cephalonica* (Stainton) are discussed. The intrinsic rates of increase were 0.039, 0.032 and 0.028 per female per day on *S. litura*, *E. vittella* and *C. cephalonica*, respectively. The population multiplied 44.44, 24.79 and 19.36 times in the cohort generation time of 115.19, 121.82 and 133.19 days on *S. litura*, *E. vittella* and *C. cephalonica*, respectively.

KEY WORDS: *Acanthaspis pedestris*, *Corcyra cephalonica*, *Earias vittella*, intrinsic rate of increase, life table, *Spodoptera litura*

One of the objectives of pest management is the estimation of the growth rate of pests and their natural enemies (Howe, 1953), and life table study is one of the useful numerical aids in studying population biology (Southwood, 1978), thereby enabling determination of age distribution and mortality rate in natural populations. It facilitates assessment of various components of the environment which are responsible for maintenance of a population in nature. Reduviids have considerable potential to act as biocontrol agents. *Acanthaspis pedestris* Stål preys on several important insect pests (Ambrose, 1988, 1998; Sahayaraj, 1991). The prey insects significantly influence rate of development, survival and reproductive potential of insects which ultimately determine the rate of population build-up. A perusal of literature reveals paucity of information on life table of *A. pedestris*.

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Hence, the present studies aim at generating information on biology and life table of *A. pedestris* on three common insect pests namely, *Spodoptera litura*, *Earias vittella* and *Corcyra cephalonica* to enable augmentation and subsequent release in the field for control of insect pests.

MATERIALS AND METHODS

Adults of *A. pedestris* were collected from Kumbakkarai scrub jungle (foot hills of Kodaikanal), Madurai district of Tamil Nadu and reared in the laboratory at Entomology Research Institute, Loyola College, Chennai on larvae of *S. litura*, *E. vittella* and *C. cephalonica* separately in 200cc plastic containers from January to December, 1997. A cohort consisting of 100 eggs from each set was used to construct life tables. Eggs were collected and allowed to hatch in small plastic containers (60cc) with moistened cotton swabs for maintaining humidity (85%). The cotton swabs were changed periodically to prevent fungal attack. After hatching, all the nymphs were reared individually in plastic containers (60cc) and fourth instar larvae of *S. litura*, *E. vittella* and *C. cephalonica* were provided as prey for respective cohort. Observations were made on hatching, completion of nymphal development, adult emergence, fecundity and age specific mortality in respective stages. The differences in the biological parameters of *A. pedestris* on different prey species were subjected to analysis of variance (SAS Institute, 1988) and Tukey test (Tukey, 1953). Life tables were constructed according to the methods of Birch (1948) elaborated by Howe (1953) and Southwood (1978).

In life table statistics, the intrinsic rate of increase was determined by using the equation $\sum_x e^{-r} m^x \, l_x \, m_x = 1$, where e is the base of natural logarithms, x is the age of the individuals in days, l_x is the number of individuals alive at age x as the proportion of 1, and m_x is the number of female offsprings produced per female in the age interval x. The sum of the products $l_x m_x$ is the net reproductive rate (R_o). The rate of multiplication of population for each generation was measured in terms of females produced per generation. The precise value of cohort generation was calculated as follows:

$$T_c = \frac{\sum l_x m_x x}{R_o}$$

The arbitrary value of innate capacity for increase r_c was calculated from the equation

$$r_c = \frac{\log_e R_o}{T_c}$$

This is an appropriate r_m value. The values of the negative exponent of $e^{-r}{}_m x$ ascertained from this experiment often lay outside the range. For this reason both sides of the equation were multiplied by a factor of $\sum e^{7-r}{}_m x \, l_x \, m_x = 1096.6$ (Birch, 1948). The two values of $\sum e^{7-r}{}_m x \, l_x \, m_x$ were than plotted on the horizontal axis against their respective arbitrary r_m on the vertical axis. Two points were then joined to give a line which was intersected by a vertical line drawn from the desired value of $e^{7-r_m} \times l_x m_x$ (1096.6).

The precise generation time (T) was then calculated from the equation

$$T = \frac{\log_e R_o}{r_m}$$

The finite rate of increase (λ) was calculated as e^{r_m}. The weekly multiplication of predator population was calculated as $e^{r_m 7}$. The doubling time was calculated as log 2/ log λ.

RESULT AND DISCUSSION

Biological parameters of the predator, *A. pedestris* are presented in the Table 1. Egg incubation period and total nymphal duration were less on *S. litura* than on *E. vittella* and *C. cephalonica*. On the contrary adult longevity and fecundity were more on *S. litura* when compared with *E. vittella* and *C. cephalonica*. The shortest developmental period of *A. pedestris* on *S. litura* may be due to the minimum stress developed during predation on less number of prey due to the comparatively larger size with richer body tissues. This confirms the observation of Anderson (1962). Venkatesan *et al.* (1997) reported higher and faster development of reduviid, *Cydonocoris gilvus* on the prey, *S. litura* than on *Oxya nitidula* and *Odontotermes obesus*. Higher longevity and fecundity of *A. pedestris* on *S. litura* may be due to the higher primary nutrients in *S. litura*. Extended longevity and higher fecundity on preferred prey has been reported for

Table 1. Biological data of *A. pedestris* on three pests (n=20; $\bar{x} \pm SD$)

Parameters	Prey species		
	S. litura	*E. vittella*	*C. cephalonica*
Incubation period	17.55 ± 1.32[a]	17.60 ± 0.69[a]	20.90 ± 0.72[b]
Nymphal duration			
I instar	8.84 ± 0.60[a]	11.00 ± 0.73[b]	12.00 ± 0.65[b]
II instar	8.90 ± 0.45[a]	9.22 ± 0.43[a]	10.42 ± 0.51[b]
III instar	9.90 ± 0.55[a]	12.18 ± 0.53[b]	13.61 ± 0.61[c]
IV instar	12.63 ± 0.72[a]	14.82 ± 0.64[b]	17.50 ± 0.61[c]
V instar	20.69 ± 0.79[a]	25.47 ± 1.41[b]	25.67 ± 0.62[b]
Total developmental period	78.13 ± 2.06[a]	91.93 ± 2.28[b]	100.14 ± 2.21[c]
Adult longevity	115.88 ± 37.77[a]	93.53 ±18.53[b]	79.79 ± 13.08[c]
Preovipositional period	16.38 ± 1.30[a]	29.67 ± 1.66[b]	38.43 ± 1.81[c]
Fecundity	121.00 ± 35.99[a]	95.11 ±14.89[b]	87.57 ± 14.08[b]

other reduviids *Neohaematorrophus therasii* and *C. gilvus* (Sahayaraj and Ambrose, 1994; Venkatesan *et al.*, 1997).

The survival of adult females and the number of females born are shown in the Figs 1-3. The results indicate that both the survival and the female birth of *A. pedestris* varied when reared on three different prey species. The highest survival and female birth were noted on *A. pedestris* reared on *S. litura* and the lowest on those reared on *C. cephalonica*. The net reproductive rate (R_o) of *A. pedestris* was significantly higher on *S. litura* (44.44) than on *E. vittella* (24.79) and *C. cephalonica* (19.36). The intrinsic rate of population increase (r_m) was 0.039, 0.032 and 0.028 on *S. litura* , *E. vittella* and *C. cephalonica*, respectively. The mean length of generation was shorter on *S. litura* (115.19 days) followed by *E. vittella* (121.82 days) and *C. cephalonica* (133.20 days). The corrected generation time was 97.298, 100.33 and 105.83 for *S. litura* and *E. vittella* and *C. cephalonica*, respectively. Consequent to the decrease in r_m and extension of developmental period, the population doubling time on *E. vittella* and *C. cephalonica* increased to 21.35 and 25.10 days from 17.67 days of that reared on *S. litura*. The weekly multiplication rate on *S. litura*, *E. vittella* and *C. cephalonica* were 1.31, 1.25 and 1.22 days, respectively.

All life table statistics varied with the prey species. The population growth statistics indicated the capability of rapid increase in population size with a possibility of bringing about an effective check of pest populations. This was in line with the

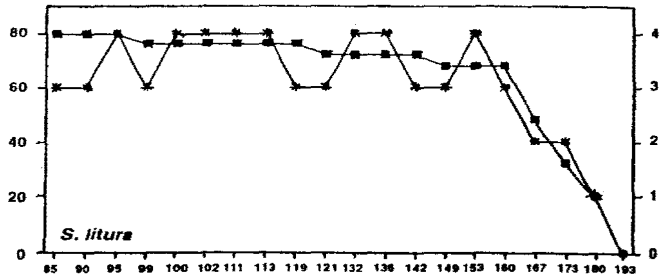

Fig. 1. Survival and the fecundity rate of *A. pedestris* on *S. litura*

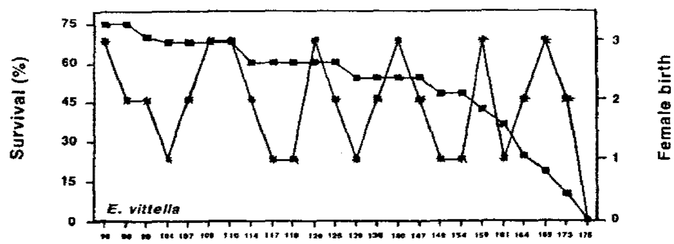

Fig. 2. Survival and the fecundity rate of *A. pedestris* on *E. vittella*

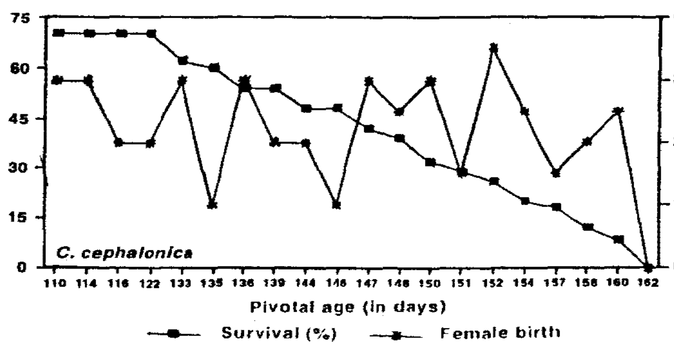

Fig. 3. Survival and the fecundity rate of *A. pedestris* on *C. cephalonica*

observation of Sharma and Bhalla (1995) who reported that even a limited number of predator *Eupeodus corollae* (Fabricius) were effective in suppressing cabbage aphids. The predatory mirid bug, *Cyrtorhinus lividipennis* Reuter was able to reduce the eggs and hoppers in the rice ecosystem and high net reproductive rate and intrinsic rate of population increase have been reported when reared on their preferred hosts (Kumar and Velusamy, 1995).

Venkatesan *et al.* (1997) reported that when reduviid predators and insect were well synchronized, the pest infestation was reduced substantially.

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