J. Biol. Control, 12 (2): 107-111, 1998

Life table and intrinsic rate of increase of *Sycanus collaris* Fabricius (Heteroptera: Reduviidae), a predator of *Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae)

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ABSTRACT: The life table studies on *Sycancus collaris* Fabricius (Heteroptera: Reduviidae) under laboratory conditions revealed that the net reproductive rate (R_0) of the species was 30.46 female eggs / female. The true intrinsic rate of natural increase (r_m) was 0.066. The population multiplied 1.59 times every week and the time taken for the doubling of predator was 10.56 days. The total nymphal duration was 49.3 ± 1.95 days. The life span of females was more (45.17 ± 1.83 days) than males (31.83 ± 2.48 days).

KEY WORDS: Development, intrinsic rate of increase, life table, net-reproductive rate, *Spodoptera litura, Sycanus collaris*

Sycanus collaris Fabricius (Heteroptera: Reduviidae) is an important reduviid reported to feed upon many lepidopteran insect pests (Ambrose and Paniadima, 1988). *Spodoptera litura* (Fabricius) is a major lepidopteran insect pest on many crop plants. A perusal of literature reveals paucity of information on life table of predatory bugs on lepidopteran pests. Life table is the most useful numerical aid in studying population biology (Southwood, 1976) enabling determination of age distribution and mortality rate in natural populations. Life tables also provide a valuable picture on the fecundity and growth potential of the predator under prevailing environmental conditions. Hence, the present study aims at generating useful information in biology and also in constructing the population model of *S. collaris on S. litura.*

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MATERIALS AND METHODS

Adults and nymphs of *S. collaris* were collected from the foot hills of Kodaikanal (10.0° N, 78.0° E), Madurai District of Tamil Nadu, India and maintained in the laboratory at Entomology Research Institute, Loyola College, Chennai from January to December, 1997 at temperature 30 ± 2° C; relative humidity 75-80 per cent; photoperiod 11-13h on the larvae of *S. litura* collected from cotton fields at Theni (9° 59' N, 77° 25' E), Madurai District of Tamil Nadu. Following mating, eggs were collected with the help of a camel brush and allowed hatching in small plastic containers (4cm diam; 4cm ht) with moistened cotton swabs for maintaining optimum humidity. The cotton swabs were changed periodically to prevent fungal attack. After hatching all the nymphs were reared individually in the same size plastic containers on 4 days old *S. litura* as the prey. Advanced larval stages were provided for the progressed nymphal instars. Observations were made on hatching, nymphal development, adult emergence, and age specific mortality in respective stage. After the emergence of adult, life table was constructed using Birch (1948) formula as elaborated by Howe (1953) and Watson (1964).

In life table statistics, the intrinsic rate of increase was determined by using the equation $\sum_{\xi} e^{-r}m^{x}l_{x}m_{x} = 1$, where 'e' is the base of the 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:

$$T_x = \frac{\sum l_x \mu_\xi}{P_o}$$

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^{-mx} ascertained from this experiment often lay outside the range. For this reason both sides of the equation were multiplied by a factor of $\sum \varepsilon^{7-\rho} \mu^{\xi} l_x \mu_\xi = 1096.6$ (Birch, 1948). The two values of $\sum \varepsilon^{7-\rho} \mu^{\xi} l_x \mu_\xi$ were then plotted on the horizontal axis against their respective arbitrary 'r_m' on the vertical axis. Two points were then joined to give a line that was intersected by a vertical line drawn from the desired value of $e^{7-r}m^{x}\ l_x m_x$ (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.

RESULTS AND DISCUSSION

The incubation period of *S. collaris* was 7.17 ± 0.41 days and the durations of I, II, III, IV and V nymphal instars were 6.6±0.51, 6.3± 0.48, 6.9± 0.57, 13.1± 0.99 and 16.4±1.26 days, respectively. The total nymphal period was 49.3±1.95 days. Females lived longer (45.17±1.83 days) than males (31.83± 2.48 days). The pre-oviposition period of female was 10.17±1.17 days (Table 1) and the total number of eggs in the lifetime was 105.67±5.69.

The population growth statistics of *S. collaris* revealed that the net reproductive rate (30.46) was lesser than the gross reproductive rate (48.5) due to a sharp decline in the survivorship value of the parent females (Table 2). Mean length of generation (T_c) was 41.01 days that approximated the true generation time (T) of 51.82 days duration which the species multiplied 30.46 times. The innate capacity of natural increase (r_c) was 0.031 while the true intrinsic rate of increase (r_m) was 0.043. With a finite rate of increase of 1.07, the population was able to multiply 1.59 days times every week on *S. litura*. The population of the predator doubled in 10.56 days.

Table 1. Biological data of *S. collaris* on *S. litura*

Parameter	Mean ± SD (days)
Incubation period	7.17 ± 0.41
Nymphal duration	
I Instar	6.60 ± 0.51
II Instar	6.30 ± 0.48
III Instar	6.90 ± 0.57
IV Instar	13.10 ± 0.99
V Instar	16.40 ± 1.26
Total nymphal duration	49.30 ± 1.95
Longevity	
Male	31.83 ± 2.48
Female	45.17 ± 1.83
Pre-oviposition period	10.17 ± 1.17

Table 2. Population growth statistics of *S. collaris* reared on *S. litura*

Growth reproductive rate (GRR)	48.50
Net reproductive rate (R_o)	30.46
Mean length of generation (T_c)	41.01
Innate capacity for increase in numbers (r_c)	0.031
Corrected r_m	0.043
Corrected generation time (T)	51.82
Finite rate of increase in numbers (l)	1.07
Weekly multiplication	1.59
Doubling time (days)	10.56

The population growth statistics indicated the capability of rapid increase in population size with a strong possibility of bringing about an effective check of *S. litura* population. Venkatesan *et al.* (1997) reported that the reduviid *(Cydnocoris gilvus Burm.)* bug with efficient oviposition and voracious feeding, was effective in suppressing the population of *S. litura*. Similar results were reported by Claver (1998) with the reduviid, *Rhynocoris kumarii* Ambrose and Livingstone. The studies carried out to evaluate the reproductive potential of *S. collaris* on *S. litura* were restricted to the laboratory. Though the results obtained so far were promising, the actual potential of this predator could be assessed only after conducting large scale release and subsequent evaluation studies.

ACKNOWLEDGMENTS

The authors express their thanks to Prof. T. N. Ananthakrishnan, Chairman and Principal investigator, Entomology Research Institute, Loyola college, Chennai for institutional facilities and suggestions. Thanks are also due to the Ministry of Environmental and Forests, New Delhi for financial support.

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