J. Biol. Control, 13: 33-38, 1999

Biology and life table of *Rhynocoris marginatus* (Fabricius) (Heteroptera: Reduviidae) on three lepidopteran insect pests

P. J. EDWARD GEORGE
Entomology Research Unit
St. Xavier's College, Palayamkottai 627 002, Tamil Nadu, India

ABSTRACT: Fecundity and adult longevity of both the sexes in *Rhynocoris marginatus* (Fabricius) were maximal while total developmental period was minimal when this reduviid predator was reared on larvae of *Spodoptera litura* (Fabricius) in place of *Earias vittella* (Boisduval) or *Corcyra cephalonica* (Stainton). Its intrinsic rate of increase and net reproductive potential were of the highest order if the predator always fed on caterpillars of *S. litura*.

KEY WORDS: *Corcyra cephalonica, Earias vittella,* life table, predator, prey influence, *Rhynocoris marginatus, Spodoptera litura*

Several species of reduviids prey upon a wide range of insects of various sizes, holding promise as useful agents in biological control of crop pests. *Rhynocoris marginatus* (Fabricius) is one such predator of various economically important insect pests such as *Corcyra cephalonica* (Stainton) (Bhatnager *et al.*, 1983), *Dysdercus cingulatus* (Fabricius), *Earias insulana* (Boisduval), *Spodoptera litura* (Fabricius) (Sahayaraj, 1994), *Anomis flava* (Fabricius), *Achaea janata* (Linnaeus), *Helicoverpa armigera* (Hubner) (Prabakar, 1994) and *Mylabris pustulata* (Thunberg) (Ambrose *et al.*, 1996). It is known that food value influences the growth rate, survival (O'Neil and Wiedenmann, 1990; Ambrose and Rani, 1991), reproductive potential and life table characteristics of the predator determining the population build-up of the latter. Acquisition of such knowledge enables adoption of steps for augmenting predator population for release in the field as a biocontrol agent in an insect pest management programme. It is from this standpoint that the present investigation has been undertaken and the information incorporated in this paper examine these issues with respect to *R. marginatus* reared on *S. litura, E. vittella* or *C. cephalonica*.

MATERIALS AND METHODS

The adults of *R. marginatus* were collected from Kumbakkarai scrub jungle (10°N, 78°E), Madurai district of Tamil Nadu and reared in the laboratory separately on mature fourth instar larvae of *Spodoptera litura, Earias vittella* or *Corcyra cephalonica* in plastic containers (6cm diam, 6cm ht) covered on the top by plastic lids with holes for aeration. A cohort consisting of 100 eggs of the predator from each such reared set was used to construct life tables. These eggs were allowed to hatch in small plastic vials (4 cm diam, 4 cm ht) in which moistened cotton swabs were kept for maintaining optimum humidity (85%). The cotton swabs were changed periodically to prevent fungal attack. After noting egg hatchability, all the newly hatched nymphs were reared individually in another set of plastic vials of similar dimensions. Fourth instar larvae of *S. litura, E. vittella* or *C. cephalonica* were provided as prey for the respective cohort. Observations were made on nymphal duration, adult emergence, their total developmental time, age specific mortality, adult longevity and egg output of mated females in their lifetime. Differences in biological parameters for the three prey species were analysed by one way ANOVA (SAS Institute, 1988) and Tukey test (Tukey, 1953).

Life tables were constructed according to the methods described by Birch (1954) and elaborated by Southwood (1978). In life table statistics the intrinsic rate of increase was determined by using the equation $\Sigma e^{-r_m x} l_x m_x$-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 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.

$$T_c = \frac{\Sigma l_x m_x}{R_o}$$

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 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 $\Sigma e^{7} - r_m x\ l_x m_x$ - 1096.6 (Birch, 1954). The two values of $\Sigma e^{7} - r_m x\ l_x m_x$ 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, which was intersected by a vertical line drawn from the desired value of $e^{7} - r_m x l_x m_x$ -1096.6.

The point of intersection gives the value of 'r_m' accurate to three decimal places.

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

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

The finite rate of increase (λ) was calculated as erm. The weekly multiplication of predator population was calculated as $(e^{rm})^7$. The doubling time was calculated as log2/logλ.

RESULTS AND DISCUSSION

Egg incubation period and total developmental duration were shortest and adult longevity of both sexes was maximal when individuals were reared on larvae of *S. litura* instead of on caterpillars of *E. vittella* or *C. cephalonica* (Table 1). Fecundity per female was also highest if this predator preyed on larvae of *S. litura*.

Table 1. Biological data of *R. marginatus* reared on three insect pests ($\bar{x} \pm SD$)

Parameter	Prey species		
	S. litura	*E. vittella*	*C. cephalonica*
Incubation period	9.00 ± o[a]	9.75 ± 0.72[b]	9.90 ± 0.47[b]
Nymphal duration			
I instar	9.25 ± 0.44[a]	9.45 ± 0.51[a]	10.25 ± 0.64[b]
II instar	8.25 ± 0.79[a]	8.74 ± 0.45[b]	9.06 ± 0.80[c]
III instar	9.75 ± 0.64[a]	10.50 ± 0.62[b]	11.6 ± 1.15[c]
IV instar	11.82 ± 0.52[a]	13.69 ± 0.48[b]	16.13 ± 0.52[c]
V instar	22.50 ± 0.78[a]	24.79 ± 0.70[ab]	26.47 ± 0.52[b]
Total developmental period	70.38 ± 2.22[a]	76.93 ± 2.09[b]	83.47 ± 2.67[c]
Longevity	79.87 ± 12.13[a]	68.47 ± 12.49[b]	65.29 ± 11.04[b]
Pre –oviposition period	20.43 ± 2.84[a]	23.42 ± 3.14[b]	28.75 ± 3.77[c]
Fecundity	191.89 ± 39.69[a]	151.44 ± 30.69[b]	121.75 ± 25.15[c]

Means followed by the same alphabet in a row are not statistically significant by Tukey test (P> 0.05).

The life table parameters of *R. marginatus* in relation to three prey insects are given in Table 2. Highest survival and maximum female progeny were noted when reared on caterpillars of *S. litura*. The net reproductive rate (R_o) was significantly higher if the prey was larvae of *S. litura* instead of *E. vittella* or *C. cephalonica*. The intrinsic rate of population increase of *R. marginatus* was maximal in respect of *S. litura* larvae wherein the mean length of generation and population doubling time were also shortest. Further, the weekly multiplication rate of the predator raised on this prey was fastest.

Table 2. Population growth of *R. marginatus* reared on three prey species

Parameter	Prey species		
	S. litura	*E. vittella*	*C. cephalonica*
Gross reproductive rate (GRR)	96.00	75.00	60.00
Net reproductive rate (R_0)	65.95	41.35	27.90
Mean length of generation (T_c)	100.34	112.15	110.82
Innate capacity for increase in numbers (r_c)	0.042	0.033	0.031
Corrected (r_m)	0.048	0.039	0.035
Corrected generation time (T)	87.27	95.44	95.10
Finite rate of increase in numbers	1.049	1.040	1.035
Weekly multiplication rate (WMR)	1.399	1.314	1.278
Doubling time (DT)	14.49	17.67	20.15
Hypothetical females in F_2 generation	4349.40	1709.82	778.41

The shortest total developmental period recorded in *R. marginatus* when reared on *S. litura* might be the consequence of better nutrition obtained by the predator with minimum expenditure of energy during predation. Similar observations were made by Anderson (1962) on *Anthocoris* spp., Venkatesan *et al.* (1997) on a *Cydnocoris gilvus* (Burm.) and George *et al.* (1998) on *Acanthaspis siva* (Distant).

The highest fecundity of females and maximum longevity of adults of both sexes following rearing of this reduviid species on larvae of *S. litura* noted in this investigation also seem to be a reflection of the superior nutritional quality of such prey diet (George, 1999). This conclusion concurs with the influence drawn by Venkatesan *et al.* (1997) and George *et al.* (1998). They also observed high egg output and maximum longevity in reduviids C. gilvus and *A. siva* reared on *S. litura.*

In the present study, larvae of *S. litura* as prey of *R. marginatus* was found to favour faster development, longer survival, greater egg output, higher net reproductive rate and shorter population doubling time of the predator. It suggests that, in biocontrol programmes, predators using considerable attention is needed to select the appropriate prey species for population build-up of predators.

ACKNOWLEDGEMENTS

I wish to express my gratitude to Rev. Fr. Antony A. Poppuraj, S. J., Principal, St. Xavier's College (Autonomous), Palayamkottai for the facilities. My sincere thanks to Dr. Dunston P. Ambrose, Director, Entomology Research Unit, St. Xavier's College (Autonomous) for the continued encouragement and DST New Delhi for financial assistance under Young Scientist Scheme (HR / OY / Z - 07 / 97).

REFERENCES

Ambrose, D. P. and Rani, M. R. S. 1991. Prey influence on the laboratory mass rearing of *Rhynocoris kumarii* Ambrose and Livingstone, a potential biological control agent (Insecta: Heteroptera: Reduviidae). Journal of Mitterand Zoological Museum Berlin, **67** (2): 339 – 349.

Ambrose, D. P., Claver, M. A. and Mariappan, P. 1996. Functional response of *Rhynocoris marginatus* Fab. (Heteroptera: Reduviidae) to *Mylabris pustulata* Thunb (Coleoptera: Meloidae). *Fresenius Environmental Bulletin,* **5:** 85 – 89.

Anderson, N. H. 1962. Growth and fecundity of *Anthocoris* spp. reared on various prey (Heteroptera: Anthocoridae). *Entomology Experimental & Applied.* **5:** 40 – 52.

Bhatnagar, V. S., Sithananthan, S. S., Pawar, C. S., Jadav, D., Rao, V. R. and Reed, W. 1983. Conservation and augmentation of natural enemies with reference to integrated pest management in chickpea *(Cicer arietinum* L.) and pigeonpea (*Cajanus cajan* L.) Millsp. *Proceedings of International Workshop on IPM for grain legumes,* Goiani, Brazil, pp. 157–180.

Birch, S. 1954. The intrinsic rate of natural increase in an insect population. *Journal of Animal Ecology,* **17:** 15 – 26.

George, P. J. E., Seenivasagan, R. and Kannan, S. 1998. Influence of prey species on the development and reproduction of *Acanthaspis siva* Distant (Heteroptera: Reduviidae). *Entomon,* **23** (4): 69– 75.

George, P. J. E. 1999. Nutritional influence of prey on the biology and biochemistry in a harpactorine reduviid *Sycanus collaris* Fabricius. *Journal of Insect Science* (In press).

O' Neil, R. J. and Wiedenmann, R. N. 1990. Body weight of *Podisus maculiventris* (Say) under various feeding regimes. *Canadian Entomology,* **122**: 285 – 294.

Prabakar, V. 1994. Impact of prey deprivation on the predatory behaviour of *R. marginatus* Fab. (Insecta: Heteroptera: Reduviidae) on *Helicoverpa armigera* (Hub.). M. Phil. thesis, M. S. University, Tirunelveli, 28 pp.

Sahayaraj, K. 1994. Biocontrol potential evaluation of the reduviid predator *R. marginatus* Fab. to the groundnut pest *Spodoptera litura* (Fab.) by functional response study. *Fresenius Environmental Bulletin,* **3:** 546 – 556.

SAS Institute, 1988. SAS/STAT Users guide, release 6.03 edition. SAS Institute Incorporation, Cary.

Southwood, T. R. E. 1978. *Ecological methods: With particular reference to the study of insect population.* Chapman and Hall, London.

Tukey, J. W. 1953. The problem of multiple comparisons. Princeton University. Princeton, N. J.

Venkatesan, S., Seenivasagan, R. and Karuppasamy, G. 1997. Influence of prey species on feeding response, development and reproduction of the reduviid *Cydnocoris gilvus* Burm. (Reduviidae, Heteroptera). *Entomon,* **22** (1): 22 – 27.