ABSTRACT

Hunter reduviids have been distributed both in tropical and temperate regions in India. *Rhynocoris marginatus* (Fab.) and *Rhynocoris fuscipes* (Fab.) (Insecta: Hemiptera: Reduviidae) have been distributed in semiarid zones, scrub jungles, agro-ecosystem and tropical forests and hence, they have a lot of possibilities of facing environmental crisis. Moreover since these two reduviids were considered as a biological control agents of many economically important pests, augmentative release is an imperative one. The present investigation was undertaken in the laboratory to find out the impact of constant temperatures (10, 15, 20, 25, 30 and 30°C) and fluctuation temperatures (29 ± 1.5°C) on eggs and nymphal development and survival rate, sex ratio fecundity and hatchability at lower and higher threshold temperatures, morphometry and morphogenesis, autochthonous gut bacteria and their enzyme production and gut enzyme profile of crude whole animal carbohydrate, protein and lipid content, and immunogenic activity of whole predator DNA content and its polymorphism. Irrespective of the predators and exposure periods, constant temperatures gradually decreased when the egg hatching periods from lower temperature to higher temperature. However, the egg survival ability was diminished between 10 to 20°C, 10 - 15°C, and 35°C were not suitable for *R. marginatus* and *R. fuscipes* development. However, the nymphal developmental periods of these two reduviids were significantly diminished from 20°C to room temperature. It was also attributed in the survival rate of nymphal instars that constant temperatures were not have any impact on the
sex ratio of the two reduviids. All the tested temperatures were always in favour of female biased sex ratio. Constant temperatures reduced the pre-oviposition period, oviposition period, post-oviposition period, fecundity and hatchability, also size (length and weight) of these two reduviids. Interestingly when freshly moulted *R. marginatus* adults were subjected to serious of constant temperature, these are laid maximum number of 198 eggs/female at 30°C with 95% hatchability. Linear model analysis shows that *R. marginatus* needs 24.31 and 32.31% as lower and higher threshold. It was slightly increased to *R. fuscipes* (25.01 and 34.28% for lower and higher threshold temperatures). Morphological data reveals that total body length was gradually as well as significantly increased from 20°C (1.30 cm) to room temperature (2.08 cm). It was also recorded many morphogenesis effects both in nymphs and adults of *R. marginatus* and *R. fuscipes* at 15, 20, and 35°C.

The biological control potential studies reveals that the stage preference of *R. marginatus* fifth nymphal instars and adults were more successful in encounter the large sized preys. All the nymphal instars and adults of *R. fuscipes* mainly preferred second to fourth instar larvae of *S. litura* and second to fifth instars of *D. cingulatus*. Both *R. marginatus* and *R. fuscipes* approached their preys quickly at higher temperatures and handled more time finally the weight gain was also maximum. From this result did not observed much variation between the temperatures at 25 and 30°C.

In *R. fuscipes*, esterase activity was maximum and equal both in 30°C and room temperature. In *R. marginatus* foregut and hindgut showed maximum esterase activity at 20°C. Protease activity was higher at 25°C in fore and hindgut of both predators where as amylase and invertase activity maximum at 35°C. The
total heterotrophic bacterial population (THBP) of *R. marginatus* and *R. fuscipes* whole gut was gradually increased from 10 to 30°C. Between these two reduviids, *R. fuscipes* has maximum THBP with more number of bacterial species (13) then *R. marginatus* (11) species. Temperature specific bacterial species were also recorded in these reduviids. However *Micrococcus variance* was the predominant species both in *R. marginatus* (40.56%) and *R. fuscipes* (47.22%). All the recorded bacterial species involved in the production of hydrolytic enzymes like amylase, protease, invertase and esterase. The whole body macromolecular contents like total carbohydrate, protein and lipid was higher in *R. marginatus* than *R. fuscipes*. Similarly, the protein content of *R. marginatus* alimentary canal was higher than *R. fuscipes*.

SDS-PAGE of *R. marginatus* gut protein polypeptides was ranged from 6.5 kDa to 500 kDa. 405 kDa polypeptide was specific for *R. marginatus* at 20°C, another unique band (500 kDa) recorded at 10°C. Whereas *R. fuscipes* possessed lowest range of polypeptides such as 10.0, 12.0, 14.0, 14.3 and 16.0 kDa. All these polypeptides were common from 10 to 25°C. 20.0 kDa polypeptide was uniformly present in all the temperatures except at 30°C.

The results of PCR amplified products such as 400 and 600bp were common irrespective of the primer in *R. marginatus*. Such a similarity was not observed when *R. fuscipes* whole body DNA was amplified with OPE-8, KTG-3 and KTG-5 primers. Interestingly OPE-8, KTG-3 and KTG-5 produced a unique amplified products of 1200, 150 and 50bp in *R. marginatus*. Similar these three primers produced 950, 200 and 300bp and 100bp in *R. fuscipes*. 
Both constant and fluctuated temperatures reared reduviids fed with three pests such as *C. cephalonica* (Stainton) *D. cingulatus*, (Fab.) and *S. litura* (Fab.). Their gut and haemolymph was subjected to Indirect Enzyme Linked Immunosorbent assay (ELISA). *S. litura* fed gut and haemolymph were more immunogenic than other pests in both reduviids. Between the gut and haemolymph, it was more immune responsive that former from 25 to 30°C.