J. bio-sci. 15: 41-46, 2007 **ISSN 1023-8654**
http://www.banglajol.info/index.php/JBS/index

EFFECT OF TEMPERATURE ON THE PREDATOR, *XYLOCORIS FLAVIPES* (REUTER) (HEMIPTERA: ANTHOCORIDAE) FEEDING ON *CRYPTOLESTES PUSILLUS* (SCHON.) (COLEOPTERA: CUCUJIDAE)

M M Rahman[1], W Islam[?] and K N Ahmed[2]

Institute of Biological Sciences, Rajshahi University, Rajshahi-6205, Bangladesh
[2] BCSIR Laboratories, Rajshahi, Bangladesh

Abstract

Xylocoris flavipes (Reuter) is one of the dominant predators of many stored product insect pest including *Cryptolestes pusillus*. The influence of temperature on predator development, survival and some selected life history parameters was determined. Eggs laid/female (27.27±2.52) and egg hatching rate (%) (88.25±2.19) were highest at 30°C and lowest at 20°C (5.43±1.19 and 30.79±4.63%) respectively but no eggs laid at 15°C. Mortality among immature stages (%) was highest (51.71±1.48) at 35°C and lowest (24.25[c]±1.14) at 25°C. Developmental times decreasing with the increasing of temperature. Maximum numbers of progeny/female/day (3.55±0.76) were produced at 25°C and minimum (0.83±0.04) were at 20°C.The sex ratios (% female) of *X. flavipes* were 47.04, 56.68, 51.66 and 50.07 for 20, 25, 30 and 35°C respectively. Survivorship of ovipositing females was highest at 25°C but lowest at 35°C respectively.

Key words: *Xylocoris flavipes*, *Cryptolestes pusillus*, life history, temperature, developmental time

Introduction

Temperature plays a vital role in regulating the activities of animals and has an important quantitative effect upon insect development. The development of predators is usually delayed at low temperatures (Scopes *et al.* 1973), as a result, the rate of population growth becomes lower (or under extreme condition, zero or negative). As temperature increases, the rate of developmental activity of individuals' increases and mortality falls; as a result, the rate of population growth becomes higher. All the species have an optimum temperature at which population growth is at its maximum level. Insects are poikilothermic and its rate of development varies with temperature (Andrewartha and Birch 1954).

Several workers have described the effects of constant temperature on the life history parameters of different hemipteran predators (Arbogast 1975, Press *et al*. 1976, Parajulee *et al*. 1995, Russo *et al*. 2004, Herrera *et al*. 2005). But no information on the impact of constant temperature of *X. flavipes* on *C. pusillus* is available. This led to the present study.

Materials and Methods

The test insect, *C. pusillus* and the predator, *X. flavipes* were collected from the stock cultures maintained in the Control Temperature (CT) room, Integrated Pest Management (IPM) Laboratories, Institute of Biological Sciences, Rajshahi University, Bangladesh for ten years. Newly emerged healthy and mated female predators were introduced into a small glass vials (4.5 ×1.1cm) containing 15 larvae of *C. pusillus* (16-20-

---

[1] Present address: Lecturer, Department of Zoology, Mollah Azad Memorial College, Atrai, Naogaon, Bangladesh
[?]Corresponding author, E- mail: mwislam2001@yahoo.com

days-old) and kept at 15°C in an incubator for oviposition up to 24 hours. The mouth of the vial was covered with cotton. After 24 hours, the females were removed and the eggs of the predator were kept at the same incubator for further development and the predators were again introduced for oviposition. This procedure was continued till the death of the female predator. The same procedures were conducted at 20, 25, 30 and 35°C. All the experiments were replicated 5 times.

The data on the effects of temperature on eggs laid per female, hatching rate (%), mortality among immature stages (%), developmental time and female longevity of *X. flavipes* at five different temperature levels were also noted. The data were analyzed by analyses of variance (ANOVA).

Results

In the present study, mean total number of eggs laid per female of *X. flavipes* at 15, 20, 25, 30 and 35°C temperatures are shown in Fig.1. The mean number of total eggs laid per female of *X. flavipes* were 00, 5.43±1.19, 27.27±2.52, 25.45±2.26 and 9.77±0.73 at 15, 20, 25, 30 and 35°C respectively. Hatching rate (%) of the eggs was shown in Fig.2. The rates of hatching were 00, 30.79±4.63, 88.25±2.19, 67.61±4.71 and 44.15±2.76 at 15, 20, 25, 30 and 35°C respectively. Significant differences ($P<0.01$) were found in eggs laid per female and hatching rates at different degrees of temperatures.

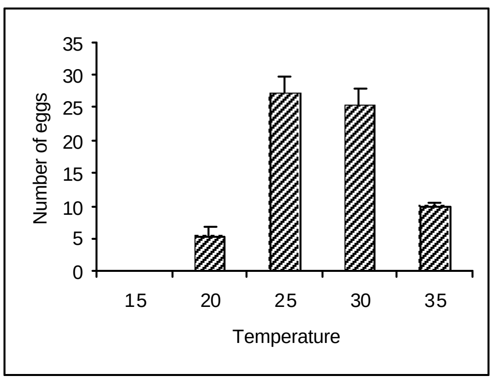


Fig.1

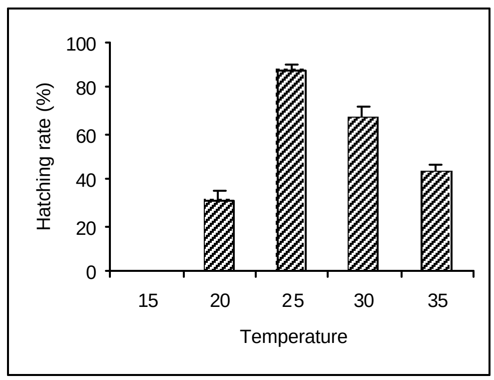


Fig. 2

Fig.1 & 2. Mean numbers of total eggs laid/female and egg hatching rate (%) of *X. flavipes* at different constant temperatures (°C)

Mortality among immature stages (%) at 20, 25, 30 and 35°C temperatures are shown in Fig. 3. Mortality among immature stages (%) were 50.36±1.65, 24.25±1.14, 33.39±1.80 and 51.71±1.48 at 20, 25, 30 and 35°C respectively. Minimum mortality was (24.25±1.14) at 25°C.

Mean number of F_1 progeny produced per female of *X. flavipes* at 20, 25, 30 and 35°C temperatures are shown in Fig. 4. The mean progeny productions for males were 2.85±0.57, 9.53±0.96, 7.46±1.14 and 3.32±0.58 and for females these were 2.46±0.47, 12.42±0.56, 7.93±0.90 and 3.31±0.47 at the same temperature conditions respectively.

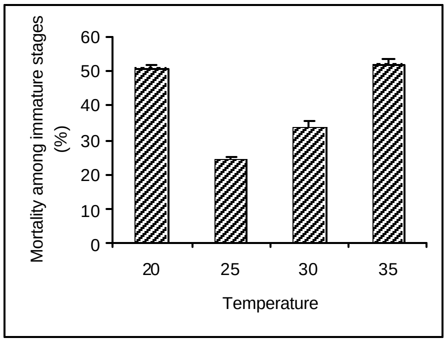


Fig. 3

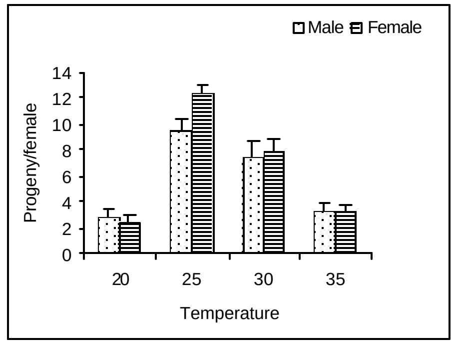


Fig. 4

Figures 3 & 4 Mean numbers of mortality among immature stages (%) and progeny/female of *X. flavipes* at different constant temperatures (°C)

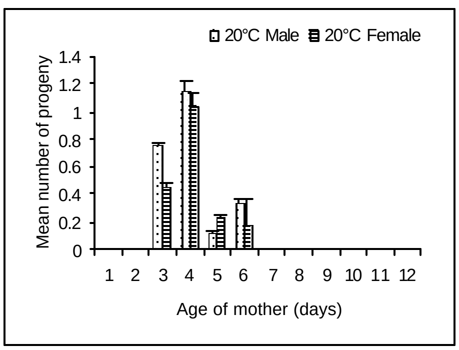


Fig. A

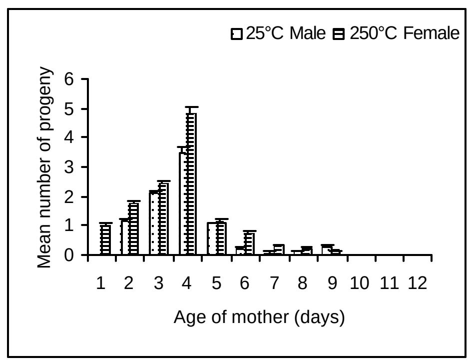


Fig. B

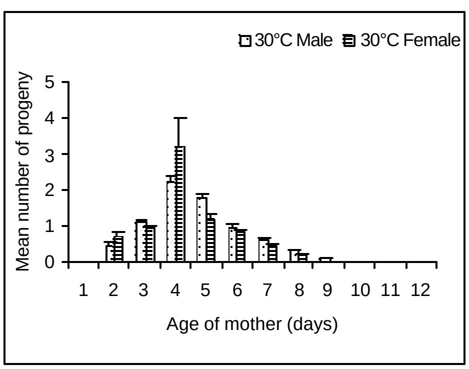


Fig. C

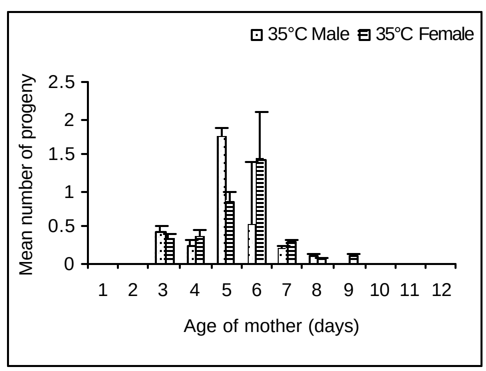
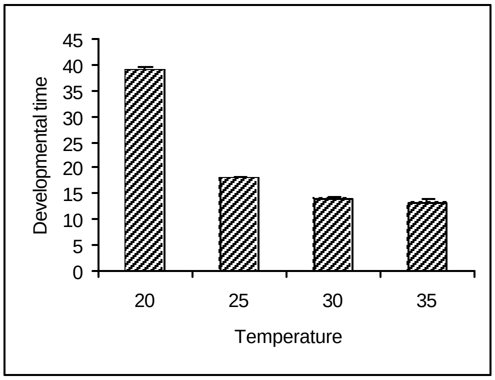


Fig. D

Fig. 5 A B C D. Age specific progeny production of *X. flavipes* at different constant temperatures (°C)

Significant differences (P<0.01) existed in progeny production at different degrees of temperatures. Age-specific progeny production was found to be dissimilar at different gradients of temperature and from 3rd to 6th day it was in peak at all temperature gradients generally Fig. 5 A B C D).



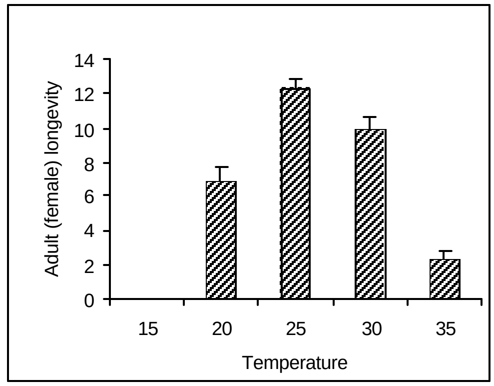
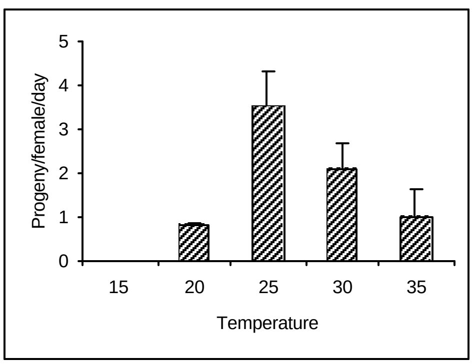


Fig. 6

Fig. 7

Figs 6 & **7** Mean developmental time and adult (female) longevity (days) of *X. flavipes* at different constant temperatures (°C).



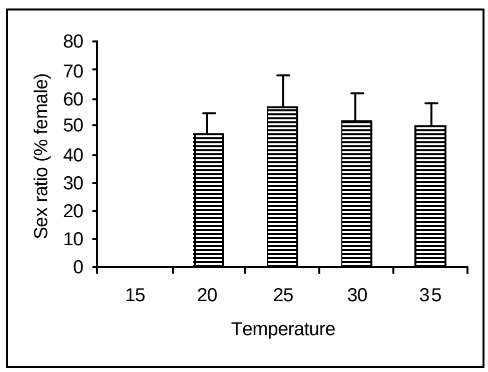


Fig 8

Fig.9

Figs 8 & **9** Mean number of Progeny/female/day and Sex ratio (% female) of *X. flavipes* at different constant temperatures (°C).

The relationship between temperature and developmental time of *X. flavipes* varied inversely. Mean development times from egg to adult emergence at different constant temperatures have been shown in Fig. 6. *X. flavipes* completed development at all the temperatures conducted except 15°C. At 20, 25, 30 and 35°C, developmental durations were 38.91±0.56, 18.01±0.36, 14.05±0.36 and 13.42±0.69 respectively. The effect of temperature on the developmental time was highly significant (P<0.01) which indicated that the developmental times of *X. flavipes* depended upon the temperatures.

Life span of the predator varied inversely with temperature. Adults of *X. flavipes* were found to be very active at the temperatures ranging from 20-30°C. The highest longevity of the females was 12.25±0.68 days at 25°C and lowest was 2.23±0.47 days at 15°C (Fig. 7).

The productions of progeny/female/day were shown in Fig. 8. The rates of daily progeny production were 0.83±0.04, 3.55±0.75, 2.11±0.56 and 1.03±0.61 at 20, 25, 30 and 35°C respectively. Significant difference ($P<0.01$) was found in progeny/female/day at different degrees of temperatures. The sex ratios (% female) of *X. flavipes* were 41.38, 45.53, 58.52, 61.01 and 41.40 (Fig. 9) for 15, 20, 25, 30 and 35°C.

Discussion

Temperature and humidity are usually two of most important abiotic factors affecting the population dynamics of insects in storage system (Flinn and Hagstrum 1990). Fecundity (total eggs laid) was adversely affected by low and high temperatures. The mean numbers of total eggs laid per female were 5.43, 27.27, 25.45 and 9.77 at 20, 25, 30 and 35°C respectively. At low temperature (20°C), the production of egg was minimum and it was maximum at 25°C but no females laid any egg at the lowest temperature (15°C). Russo *et al.* (2004) reported that at low temperatures (from 19 to 32°C), adult *X. flavipes* survived no more than 4-5 days and female's egglaying are in accordance with the present results.

Russo *et al.* (2006) observed the life fertility tables of *Piophila casei* L. (Diptera: Piophilidae) reared at five different temperatures (15, 19, 25, 28 and 32°C) and resulted that mean total fecundity per female was higher at 25°C and lower at 15 and 19°C whereas the best performance in mean daily total fecundity per female was recorded at 32°C which are more or less similar to the present findings.

Egg hatching rate (%) was maximum (88.25%) at 25°C and it was minimum (30.79%) at 20°C in the present investigation. Parajulee *et al.* (1995) reported that the mean eclosion rates (egg hatching rate) were 78, 86, 80 and 83% at 17, 21, 25, and 29°C respectively and these did not vary with temperature. Present results agree with this view. Herrera *et al.* (2005) estimating the temperature-dependent (from 15-40°C) developmental rates of *Diorhabda elongata* (Coleoptera: Chrysomelidae), a biological control agent of Saltcedar (*Tamarix* spp.) and concluded that at 15 and 40°C, eggs did not developed and sustained 100% mortality which are similar to the present findings. Legaspi and Legaspi Jr (2005) observed the life table analysis of *P. maculiventris* immatures and female adults under four constant temperature (18, 22, 26 and 30°C) and stated that the percentage of egg hatching was lowest at 18°C (11%) and highest at 30°C (36.4%). Russo *et al.* (2006) reported that the lowest mortality percentage of eggs was recorded at 15°C and the highest at 32°C, which are in accordance with the present results.

In the present investigation, *X. flavipes* completed development at all the temperatures conducted except 15°C. At 20, 25, 30 and 35°C developmental durations were 38.91±0.56, 18.01±0.36, 14.05±0.36 and 13.42±0.69 respectively. Herrera *et al.* (2005) reported that all three larval stages, the developmental time decreased with increasing temperature between 20 and 35°C and increased at 40°C. Developmental times also decreased with increasing temperature between 20 and 35°C for the pupal stage as did total developmental time from egg to adult that are in accordance with the present results. Russo *et al.* (2006) observed that the developmental time of *P. casei* from first instar to adult decreased with the increasing temperature of 32°C and it was 13.7 days.

In the present study, mortality among the immature stages (%) was highest (51.71%) at 35°C and lowest (24.25%) at 25°C. Arbogast (1975) reported that mortality among the immature stages of *X. flavipes* was highest at 35°C which complies with the present results. Russo *et al.* (2006) observed the life fertility tables of *P. casei* reared at five different temperatures (15, 19, 25, 28 and 32°C) and expressed that less mortality was observed for maggots at higher temperatures.

In the present experiment, longevity of individual adult female was highest (12.25 days) at 25°C and lowest (2.23 days) at 15°C. Mean oviposition period was also highest (10.91 days) at 25°C but lowest (1.55 days) at 35°C. Arbogast (1975) reported that the life-span and oviposition period of *X. flavipes* were maximum at 20°C but the maximum rate of oviposition occurred in temperatures of 25 and 30°C that are in accordance with the present results. Russo *et al.* (2006) reported that the adult longevity of *P. casei* was strongly affected by temperature, decreasing from 20.5 d at 15°C to 6.6 d at 32°C. That is more or less similar to the present findings.

The sex ratio (% females) of emerging adults of *X. flavipes* ranged from 0.98 to 0.76 at different temperature levels, but it was not significantly different from 1: 1 for any of the temperatures. Russo *et al.* (2004) reported similar results for *X. flavipes*. Parajulee and Phillips (1993) reported a similar sex ratio of *Lyctocoris campestris* (Hemiptera: Anthocoridae) at 30°C and 60-70 % relative humidity.

Acknowledgements

The authors would like to thank to the Director, Institute of Biological Sciences, University of Rajshahi, Bangladesh for providing laboratory facilities.

References

Andrewartha H G and Birch L C (1954) *The distribution and Abundance of animals*. Chicago, University of Chicago Press, pp. 782.

Arbogast R T (1975) Population growth of *Xylocoris flavipes* (Reuter): Influence of temperature and humidity. *Environ. Entomol.* **4:** 825-831.

Flinn P W and Hagstrun D W (1990) Simulations comparing the effectiveness of various stored grain management practices used to control *Rhyzopertha dominica*. *Environ. Entomol.* **19:** 725-729.

Herrera A M, Dahlsten D D, Tomic-Carruthers N and Carruthers R I (2005) Estimating temperature-dependent developmental rates of *Diorhabda elongate* (Coleoptera: Chrysomelidae), a biological control agent of Saltceder (*Tamarix* spp.). *Environ. Entomol.* **34(4):** 775-784.

Legaspi Jesusa Crisostomo and Legaspi Jr C Benjamin (2005) Life table analysis for *Podisus mac uliventris* Immatures and female adults under four constant temperatures. *Environ. Entomol.* **34(5):** 990-998.

Parajulee M N and Phillips T W (1993) Effects of prey species on development and reproduction of the predator *Lyctocoris campestris* (Heteroptera: Anthocoridae). *Environ. Entomol.* **22:** 1035-1042.

Parajulee M N, Phillips T W, Thorne J E and Nordheim E V (1995) Life history of immature *Lyctocoris campestris* (Hemiptera: Anthocoridae): Effects of constant temperature and relative humidities. *Environ. Entomol.* **24:** 889-897.

Press J W, Flaherty B R and Arbogast R T (1976) The effect of low temperature on the egg hatch and subsequent nymphal survival of the predaceous bug *Xylocoris flavipes* (Hemiptera: Anthocoridae). *J. Ga. Entomol. Soc*. **11:** 150-153.

Russo A, Cocuzza G E and Vasta M C (2004) Life tables of *Xylocoris flavipes* (Hemiptera: Anthocoridae) feeding on *Tribolium castaneum* (Coleoptera: Tenebrionidae). *J. Stored Prod. Res.* **40:** 103-112.

Russo A, Cocuzza G E, Vasta M C, Simola M and Virone G (2006) Life fertility tables of Pio*phila casei* L. (Diptera: Piophilidae) reared at five different temperatures. *Environ. Entomol*. **35:** 194-200.

Scopes N E A, Biggerstaff S M and Goodal D E (1973) Cool storage of some parasites used for pest control in glasshouses. *Plant Pathol*. **20:** 111-116.