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Effect of Temperature on the Developmental Period, Progeny Production and Longevity of *Tetrastichus howardi* (Olliff) (Hymenoptera : Eulophidae)

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ABSTRACT

The developmental period of *Tetrastichus howardi* (Olliff), a parasitoid of the uzi fly, *Exorista bombycis* (Louis) showed a negative correlation with temperature. It decreased from 51.70 ± 0.64 days at 15°C to 12.83 ± 0.10 days at 30°C. Progeny production had a positive correlation with temperature upto 25°C. The upper and lower temperature threshold limits of *T. howardi* were 30°C and 15°C respectively. At 35°C and 20°C temperatures, the females survived for 4.20 ± 0.27 days and 19.80 ± 1.09 days without food, while the males lived for 3.10 ± 0.41 days and 11.70 ± 0.44 days respectively. At similar temperatures, life span for fed females were 9.20 ± 0.83 days and 30.90 ± 0.74 days and those for fed males 4.40 ± 0.41 days and 25.0 ± 0.70 days respectively.

KEY WORDS : *Tetrastichus howardi*, Parasitoid, *Exorista bombycis,* temperature, biology

Tetrastichus howardi (Olliff) is a larval-pupal endoparasitoid of the tachinid fly, *Exorista bombycis* (Louis) which is a serious endoparasitoid of silkworm larvae *Bombyx mori* L. (Lepidoptera : Bombycidae) (Krishna swami *et al.*, 1964). This fly, commonly known as uzi fly, causes considerable damage to the silkworm crop in South India (Jolly and Kumar, 1985).

The use of the parasitoid *T. howardi* against the uzi fly offers considerable promise in the biological control programme. But no effort has been made to assess its biotic potential. Some observations on the different developmental stages of this species were made by Kishore *et al.* (1992). This paper deals with some observations on the effect of temperature on the developmental period, progeny production and longevity of *T. howardi*.

MATERIALS AND METHODS

Adults of *T. howardi* were established in the laboratory (at a temperature of 26 ± 1°C and 70 ± 5% RH) on the puparia of *E. bombycis* collected from cocoon markets located in Mysore district. Adult longevity, developmental period and progeny production were observed at constant temperatures of 5, 10, 15, 20, 25, 30 and 35 ± 1°C maintained in an incubator (BOD).

In order to study the developmental period of *T.howardi*, two day old puparia of *E. bombycis* were exposed at room temperature (26-27°C) to *T. howardi* (two day-old) for six hours in conical flasks (500 ml capacity) with mouths covered with muslin cloth. The parasitised puparia were subsequently held at desired constant temperature. The puparia were dissected out at three hours interval under zoom stereo microscope to observe the incubation period and prepupal stage. Subsequently they were dissected out at the interval of 6-12 h to determine the larval and pupal periods of the parasitoid. The prepupal stage or 'Pronymphal' phase was indicated by the faintly developed eyes and lengthening of the body (Morris, 1937).

Single pairs of newly emerged male and female parasitoids were confined with 10 freshly pupated hosts in glass vials (10 x 2.5 cm) for a period of one week and mouths covered with muslin cloth. Number of parasitised puparia and sex ratio of the progeny were recorded.

To study the adult longevity, newly emerged single male and female parasitoids were confined separately in the glass vials at different temperatures with and without food as described previously. Observations were taken at 12 h interval.

Adults were fed with 50% aqueous honey streaks in glass vials. Treatments were replicated ten times. Data were subjected to statistical analysis as per the methods of Kempthrone (1952) and Fisher and Yates (1963).

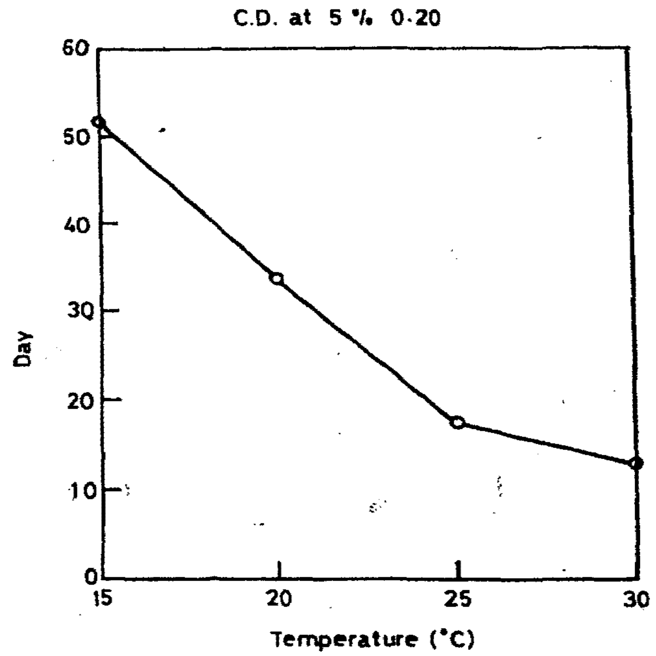

Fig.1 Effect of constant temperature on the total developmental period of *Tetrastichus howardi*

RESULTS AND DISCUSSION

Duration of the developmental stages of this parasitoid showed a negative correlation with temperature (Fig.1). Incubation period of eggs decreased from 2.75 ± 0.25 days at 15°C to 0.92 ± 0.10 days at 30°C. The eggs failed to hatch at 10 and 35°C whereas it survived for a maximum period of 13.15 ± 0.28 days at 35°C and 0.82 ± 0.10 days at 35°C. The larval, prepupal and pupal periods were shorter at 30°C being, 4.54 ± 0.08, 0.60 ± 0.13 and 6.77 ± 0.18 days respectively as against 14.25 ± 0.35, 1.50± 0.15 and 33.20 ± 0.44 days at 15°C. Shorter larval and pupal periods at higher temperature were also recorded by Browning and Oatman (1981). The average total developmental period from egg to adult ranged from 51.70 ± 0.64 days at 15°C to 12.83 ± 0.10 days at 30°C (Fig.1). Similar reduction in the life cycle at higher temperature was observed in *Chrysocaris larcinellae* Ratz. (Eulophidae) (Quednau, 1967).

The progeny production (number) was maximum at 25°C (242.0 ± 5.70) which declined significantly at other temperatures being least at 30°C (96.6 ± 10.80) (Fig.2). No progeny production was observed at temperatures below 15°C and above 30°C. A single female parasitised a maximum of 5 host puparia out of ten provided at 25°C during the period of its survival. Its parasitising ability declined significantly at other temperatures. Low progeny production by females at 15°C and 20°C reflected very low activity levels of adults at these temperatures as seen by the delayed oviposition. Natarajan and Channabasavanna (1978) reported 27 to 30°C as optimum for the mass rearing of

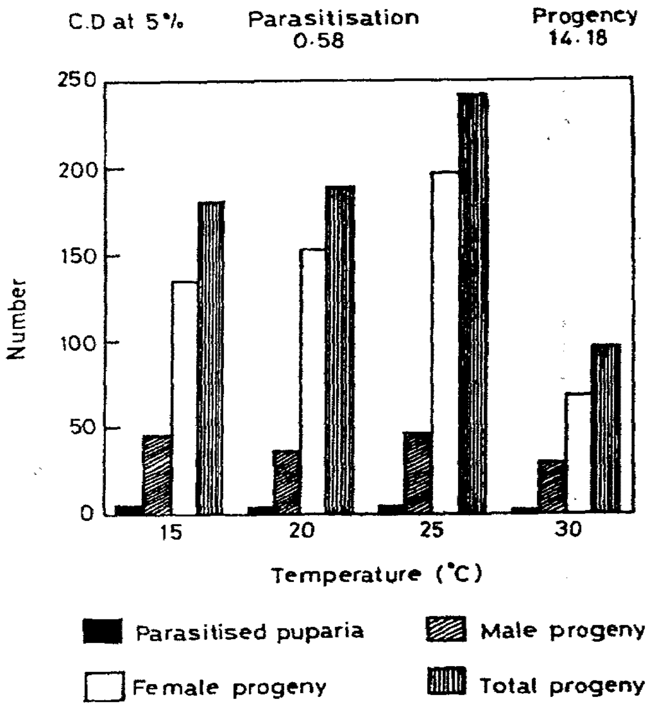

Fig.2. Effect of constant temperature on total progeny production of *Tetrastichus howardi*

Parasierola nephantidis Mueseback and *Tetrastichus israeli* Mani and Kurian (Eulophidae). On the other hand, inspite of being active at 30°C, only 96.60 ± 10.80 progeny adult parasitoids emerged. The significant decline in progeny production at 30°C could be attributed to the higher rate of pupal mortality at this temperature. At 30°C, there was a low parasitoid emergence (12.40 ± 0.54) even though the rate of deposition of eggs per host was much higher. Dissections indicated that in most of the parasitised puparia, *T. howardi* had developed but failed to emerge. Similar observations on pupal mortality and the failure of adult emergence from the host puparia at higher temperature have been made in the eulophid *Trichospilus pupivora* Ferr. (Dharmaraju, 1970). Differential mortality of sexes during development has been reported (Flanders, 1946), which was probably responsible for the altered sex ratio (male : female) at 30°C in the present studies (Fig.2).

The longevity of both the sexes was maximum at 20°C and was reduced significantly at other temperatures. At 35 and 20°C, the females without food survived for 4.20 ± 0.27 and 19.80 ± 1.09 days while the males lived for 3.10 ± 0.41 and 17.70 ± 0.44 days respectively. At similar temperatures, life span for fed females were 9.20 ± 0.83 and 30.90 ± 0.74 days and those for fed males were 4.40 ± 0.41 and 25.0 ± 0.70 days respectively (Fig.3). Similarly the adult female lived longer in the case of *Pediobius faveolatus* (Eulophidae) (Mary *et al.*, 1987). Bryan *et al.* (1969) also observed a similar response in the female longevity of *Laspesia archippivora* (Riley), which lived for 49.0 days at 15°C and 12.0 days at 30°C.

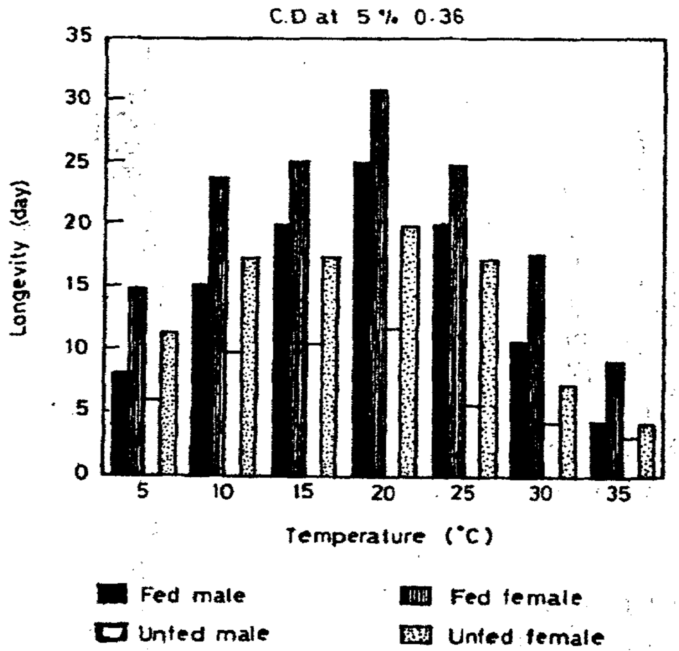

Fig.3. Effect of constant temperature on adult longevity of *Tetrastichus howardi*

Ovipositing females lived shorter compared to non-ovipositing females at 15 to 30°C. Similar observation was made with *Allorhogas pyralophagus* by Melton and Browning (1986).

In the light of the above results, it appears that *T. howardi* can reproduce at a higher rate than the host (Kumar, 1987) and by maintaining numerically high number, it would be possible to achieve reciprocal balance with the parasitoid population subject to its host searching capacity in the field.

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