Research Article

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Influence of temperature on biological parameters of *Goniozus nephantidis* Mues. and *Elasmus nephantidis* Rohw., two promising parasitoids of the coconut black headed caterpillar, *Opisina arenosella* Wlk.

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Abstract

Laboratory studies on the influence of temperature on two major parasitoids, *Goniozus nephantidis* Mues. and *Elasmus nephantidis* Rohw., of coconut leaf eating caterpillar *Opisina arenosella* Walker were undertaken. *Goniozus nepahntidis* exhibited optimum parasitization efficiency at 30^{O}C with 37 days of longevity. The fecundity was 42 eggs/female. The parasitoid tolerated the temperature regimes of 20 ^{O}C to 40^{O}C. *Elasmus nephantidis* showed temperature specificity with higher parasitization efficiency at 25^{O}C with 17 days longevity and fecundity of 116 eggs / female. *G. nephantidis* and *E. nephantidis* exhibited higher longevity of 63-70 days and 26-78 days respectively at lower temperatures regimes of 10-15 ^{O}C, with no egg laying.

Key words: Goniozus nephantidis, Elasmus nephantidis , Opisina arenosella, Temperature tolerance

Introduction

The coconut leaf eating caterpillar, *Opisina arenosella* Walker has been a problem in the coastal areas and in the interior peninsular India. The caterpillars of *O. arenosella* construct galleries of silken webs reinforced with excreta and leaf bits. They feed on the chlorophyll containing parenchymatous tissues. The pest infests coconut palm throughout the year from mild to medium intensities. Under favourable conditions, sporadic out breaks leads to severe damage to coconut plantations.

Parasitoids and predators play an effective role in natural biological suppression of *O. arenosella* in the field. Pillai and Nair (1993) enlisted 40 parasitoids and 20 predators on *O. arenosella* from India. The gregarious ectoparasitoids, *Goniozus nephantidis* Mues. (Bethylidae) affecting the larval stage and *Elasmus nephantidis* Rohw. (Elasmidae) affecting the pre-pupal stage are two important members of the parasitic complex of the coconut leaf eating caterpillar and are being used in the biocontrol programme for field release. Sathiamma *et al.*, (1987) fixed norms for field release of these effective parasitoids based on the occurrence of target stage of the pest in the filed.

Very significant biological controls of the pest problem by field release of the promising parasitoids were reported by Sathiamma *et al.*, (1996) and Chandrika and Nair (2002) from coastal Kerala. Most of the parasitoids show high location specificity in occurrence. A wide variation in effective control of the pest is reported from various agro climatic areas of India.

Temperature is a crucial factor, which influences the bio-attributes of parasitoids. It is also a major determinant in the survival and development of immature stages and reproductive performance of the parasitoids. Studies on effect of temperature may contribute to effective mass rearing and regulating field releases in adverse environmental conditions for more effective utilization of the bioagents. The lack of information on the influence of temperature on the survival,

development and reproduction of *G. nephantidis* and *E. nephantidis* has prompted this study.

Material and Methods

The experiment was conducted at CPCRI, Regional Station, Kayangulam (9° 48'N & 76°19'E). Cocoons of *G. nephantidis* and *E. nephantidis* were collected from *Opisina* infested coconut leaves from Alappuzha District. They were maintained in laboratory at 30 ± 2° C and 75-85 % RH. Parasitoid culture was reared on *O. arenosella* larvae and pre-pupae respectively. Various temperature regimes tested were 10, 15, 20, 25, 30, 35 and 40°C. Humidity was 80±5 %. Pairs (Male and female) of newly emerged parasitoid were caged in test tubes (10 x 2.5 cm) covered with cotton plug and kept in the BOD set at the fixed temperature and R.H. Honey droplets on wax coated paper strips were provided as food for adult feeding. Twenty replicates were maintained for each temperature tested. To study the effect on *G. nephantidis,* one larva of *O. arenosella* in fifth to sixth instar weighing about 70mg was introduced into the tube and each tube was observed daily for egg laying. The parasitized larvae were removed on observing egg laying and fresh larvae were provided to the parasitoid till the death of the female parasitoid. The parasitized larvae were reared individually in glass tubes under the same temperature regime and observed for adult emergence. Male and female progeny emerged were sorted and counted separately. Observations were recorded on adult longevity, fecundity, progeny sex ratio and developmental period. Similarly *E. nephantidis* was studied under the different temperature regimes, but pre-pupae of *O. arenosella* were exposed to the parasitoid for egg laying. Data were subjected to analysis of variance.

Results and discussion

Present study on the effect of temperature tolerance revealed significant variation in longevity, fecundity percentage female progeny and developmental period of both the parasitoids under various temperature levels. For *G. nephantidis,* adult longevity was significantly higher (63-70days) at lower temperatures of 10-15°C with a significantly lower fecundity. There was no egg laying at temperature regimes of 10-15°C. Highest fecundity of 42 eggs/female was observed at 30°C. Developmental period was observed to be longer at lower temperature than higher temperatures (Table 1) At higher temperature regimes of 35-40°C, *G. nephantidis* exhibited fairly good longevity, fecundity and female biased progeny though not on par with the room temperature of 30 °C. The present study indicated that *G. nephantidis* is a temperature tolerant parasitoid which can withstand higher temperature regimes of 35-40°C. This expression of temperature tolerance is a desiarable attribute as the pest population is commonly reported to attain peak during summer months. The fecundity was totally absent at temperature below 15 °C, though the parasitoid survived for longer days. Earlier work by Dharmaraju and Pradhan (1977) recorded that at 30°C, *G. nephantidis* produced the maximum number of parasitoid larvae. Remadevi, *et al.* (1978) studied the oviposition of *G. nephantidis* and reported that no oviposition occurred below 14°C or above 37°C. Pillai and Bhat (1986) reported presence of *G. nephantidis* in field through out the year with peak in summer.

Elasmus nephantidis, the pre-pupal parasitoid shows temperature specificity. At 25°C, the parasitoid exhibited better parasitization potential with regard to egg laying compared with other temperatures (Table 2). At lower temperature below 15°C and higher temperature of 40 °C, egg laying was totally absent.

Variation in the duration of development due to temperature has been reported in several hymenopteran parasites and hyper parasites. Similar results of decreasing adult longevity with increasing temperature were reported in another bethylid, *Parasierola sp.,*

Table 1. Effect of temperature on *Goniozus nephantidis*

Temperature(°C)	Female longevity(days)	Fecundity (no. of eggs / ♀)	Female progeny (%)	Egg to adult period (days)
10	70.61	0.00	0.00	0.0
15	63.72	0.00	0.00	0.0
20	37.28	17.92 (4.05)	84.57 (70.02)	19.82
25	33.89	28.06 (5.21)	68.44 (56.89)	12.13
30	37.89	42.82 (6.41)	84.30 (68.09)	11.17
35	34.39	32.33 (5.64)	73.96 (60.23)	10.81
40	30.78	38.83 (6.09)	88.16 (70.86)	11.65
F value	63.77$	146.65$	236.64$	327.74$
CD(p=0.05)	5.63	0.664	5.97	1.08

(Average of 20 replications) ($ significant at 1%) Figures in parenthesis are the transformed values.

Table 2. Effect of temperature on *Elasmus nephantidis*

Temperature (°C)	Fecundity(no. of eggs / ♀)	Female progeny (%)	Female longevity (days)	Egg to adult period (days)
10	0.00(0.00)	0.00(0.00)	26.50	0.00
15	0.00(0.00)	0.00(0.00)	78.0	0.00
20	27.2 (5.16)	72.8(58.9)	20.75	19.75
25	116.25(9.10)	84.8(67.14)	17.25	16.12
30	25.0(4.98)	79.63(63.87)	12.50	12.12
35	21.75(4.60)	89.74(71.57)	10.5	11.12
40	0.00(0.00)	0.00(0.00)	1.87	0.00
F value	17.78 $	559.48$	546.86 $	373.79 $
CD(p=0.05)	2.38	4.29	3.06	1.24

$ Significant at 1%. (Average of 20 replications) Figures in parenthesis are the transformed values

parasitizing *Pectinophora gossypiella* Saund. by Hekal (1990).

Results of the present study revealed that *Goniozus nephantidis* is comparatively tolerant to higher temperatures than *Elasmus nephantidis* which shows temperature specificity. These results indicated the suitability of *G. nephantidis* for field release in moderate to warm climatic periods (20 to 40 °C) and E. *nephantidis* for periods during mild winter to warm climate with 25-35 °C. As the parasitoids fecundity is highly reduced or nil at lower temperature regimes below 15°C, release of the parasitoids may be avoided during peak winter season in areas where temperature goes below 15°C. While mass culturing the parasitoids in the laboratory for field release room temperature of 30°C for *G. nephantidis* and 25 °C for *E. nephantidis* is the ideal temperatures for getting better progeny out turn. The results also point out the necessity to develop temperature tolerant strains of parasitoids that can thrive under varying temperature levels persisting in different agro climatic zones of the country where the pest is a major problem.

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