EFFECT OF ENVIRONMENTAL TEMPERATURE ON DEVELOPMENT, FECUNDITY, SURVIVAL AND PREDATION OF THE SNAIL-PREDATOR SARCOPHAGA MISERA (DIPT., SARCOPHAGIDAE)

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Effect of temperature (10°C-45°C) on development, fecundity, survival, population parameters, and rate of predation on snail by the fly Sarcophaga (Parasarcophaga) misera has been studied under controlled laboratory conditions. Temperatures ranging from 25°C-30°C effected higher rate of development, fecundity, and predation on the snail Indoplanorbis exustus, than at 15°C, 20°C, 35°C & 40°C. Longevity was maximum at 20°C. Implications of the role of temperature in influencing the biology and predation by this fly are discussed.

KEY-WORDS: Sarcophaga, snail, predator, Indoplanorbis, temperature, biology.

Many species of freshwater snails have been incriminated as intermediate hosts of parasitic diseases such as fascioliasis, amphistomiasis, schistosomiasis etc. (Cheesbrough, 1987; Schmidt, 1990). Indiscriminate use of molluscicides for the control of freshwater snails leads to persistence of the molluscicides in the aquatic habitat and toxicity to non-target organisms, which ultimately leads to the disturbance of the ecosystem. Various biological control agents such as the competitor snails- Marisa cornuarietis (L.) and Helisoma durai Whetherby and various species of sciomyzid flies have been recommended for the control of vector snails as a part of integrated pest management (WHO, 1993).

Some species of sarcophagids are known to feed on snails (Beaver, 1980, Coupland & Baker, 1994). Using serological techniques Parashar and Rao (1988) reported Sarcophaga (Parasarcophaga) misera (F) as a predator of the snail Indoplanorbis exustus Deshayes which is a vector of animal schistosomiasis in India (Malek & Cheng, 1974). This snail is preferably distributed in ponds and pools of temporary nature, which remain dry for 3-6 months each year, during which period it undergoes dormancy and its populations are exposed to predator/sarcophagid attack. In India, its reproductive period in natural habitats ranges from July to November when ambient temperature varies from 25-35°C, which is reported to be a favourable temperature range for its reproduction (Parashar & Rao, 1985). Depending upon the nature of habitat in relation to quantity of water available, the snails become dormant from December to June (Parashar & Rao, 1996). Therefore, S. misera has to operate in the field for different time periods depending upon the state of the habitat.

The efficiency of a predator in natural conditions is severely dependent on various environmental factors, including temperature, which directly or indirectly influences its use by affecting its reproductive potential. Little is known about the biology of S. misera. In the present study, attempts were made to investigate the effect of temperature on development, fecundity, survival, intrinsic rate of natural increase and predation by S. misera under laboratory conditions.
MATERIAL AND METHODS

The studies of the effect of temperature on development were carried out under controlled environmental conditions at 10°, 15°, 20°, 25°, 30°, 35°, 40° & 45°C and 70 ± 10% R.H. At each temperature 100 first instar larvae on batches of ten were kept in glass bottles (ht - 15 cm, diam - 10 cm) on flesh of 200 I. exustus. Data were recorded for percent larval survival up to pupation, duration for the larval period, pupal period, and percent emergence.

To study the effect of temperature on fecundity and longevity of S. miser, 10 male and 10 female flies of the same age group (one day old) were kept in cotton cages (20 × 20 × 20 cm) in three replicates at temperatures ranging from 10-45°C (RH → 70 ± 10%) until all were dead. Flies were offered milk soaked and 10% sucrose soaked cotton pads. Ten I. exustus were also provided for larviposition. The total numbers of larvae deposited by the flies was recorded daily. The number of male and female flies dead on a particular day were recorded. Correlation between temperature and the above mentioned parameters was also determined (Snedecor & Cochran, 1967).

The rate of predation by the sarcophagid larvae was studied by releasing them in a Petri dish (diam 9 cms.) containing 25 I. exustus and counting the total number of snails killed during the complete larval period at different temperatures. These experiments were conducted at 10°, 15°, 20°, 25°, 30°, 35°, 40° & 45°C for the complete larval period i.e. 18 days at 15°, 14 days at 20°, 11 days at 25°, 8 days at 30°, 5 days at 35° and 4 days at 40°C. In eight different habitats which dried in different time of the year ranging from December to April, incidence of fly larvae on their host snails has also been studied by collecting dormant snails in one square meter area. Snails were dissected to see the presence/absence of sarcophagid larvae.

Various population parameters, such as intrinsic rate of natural increase (rm), net reproductive rate (Ro), finite rate of increase (R) and mean generation time (T) of this predatory fly were determined using the methods developed by Howe (1953) and Andrawartha & Birch (1954).

RESULTS

The flies did not larviposit at 10° and 45°C. Total larviposition, larval survival and percentage of emergence were maximum at 25°C and minimum at 40°C, while the average longevity of male and female flies was greatest at 20°C and least at 10° & 40°C. However, the difference between total larval production, percentage of pupae surviving to adult stage at 25° and 30°C and male and female longevity at 15° and 20°C did not differ significantly (table 1).

The rate of predation of larvae was the greatest in the temperature range of 25-35°C and least at 15° and 40°C. At 10°C and 45°C, the larvae became quite inactive and did not predate on the snails.

Twenty flies were observed for predatory behaviour. Initial landing and probing took average 6 min (range 2 to 14) during which female fly put its abdomen in the shell opening of the snail just around its internal margin. Those larvae which were laid on the outer margin of shell aperture, entered quickly in it. Larviposition was fast (2-4 min). In snails froth appeared on the shell opening after 20-24 hrs of larval entrance. Oozing of haemolymph and froth has been recorded in all snails.

Regarding incidence of larvae in snails in natural habitats in the month of December, January and February, the incidence of snails infested with fly larvae in dried habitats ranged from 26% to 41% while in months of March-April the incidence ranged from 36% to 63%.