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97

Hookworm infection: influence of ambient climatic factors on the development and hatching of eggs and development and survival of infective larvae

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SUMMARY

The optimal periods of development and hatching of eggs and development of L_3 larvae of human hookworm seems to occur at warmer temperatures (22-28°C) and high humidity (RH>80%) which also favour a longer period of survival of L_3 larvae. The present study suggests that the ambient climatic conditions of summer months in the rural subtropical, high rainfall area of Meghalaya (North-East India) are better suited for transmission and recruitment of infection as compared to cold winter months, when no development of eggs and hence no infective larvae would occur.

INTRODUCTION

Transmission of the geo-helminthic parasites has a link to topography-related climatic variables to differing extents since their life cycle includes stages outside the host with the environment. A knowledge of the geographic distribution and seasonal occurrence of these parasites is of practical importance when devising control programs for a particular region. Temperature, moisture and day light are important limiting factors that control the hatching of the eggs and development of L_3 infective larvae of gastrointestinal helminths (Anderson,1973; Gibson and Everett, 1976; Michel, 1976; Smeal et al, 1980; Islam and Ahmed,1987). Influence of these factors has also been studied with regard to infections in the tropical South Asia (Tripathi,1980). In the present study the effect of temperature and relative humidity (RH) on the development and hatching of hookworm eggs, development

and survival period of the resulting L_3 infective larvae was determined under controlled laboratory conditions simulating ambient climatic conditions that prevail in a hookworm infested village area in a subtropical, high-rainfall region of Meghalaya (North-East India).

MATERIALS AND METHODS

The study area inluded a village, Nongkya (Umsning) in Ri Bhoi district, located about 33 km north of the state capital, Shillong (Meghalaya). The people depend for their livelihood mainly on agriculture. Freshly passed out hookworm eggs from faeces of infected subjects were collected and cultured, following modified Harada- Mori filter paper strip method (Kosin et al, 1973) in a BOD incubator at various temperatures (between 2 and 35°C) with RH of 55-60, 65-70 and 80-85% (corresponding to the ambient climatic conditions that prevail in winter and spring (i.e., late November-March), autumn (September-early November) and summer (April-August), respectively. Three replicates of each culture were prepared using sample from a single infected subject at both controlled as well as ambient temperature and humidity conditions.

RESULTS

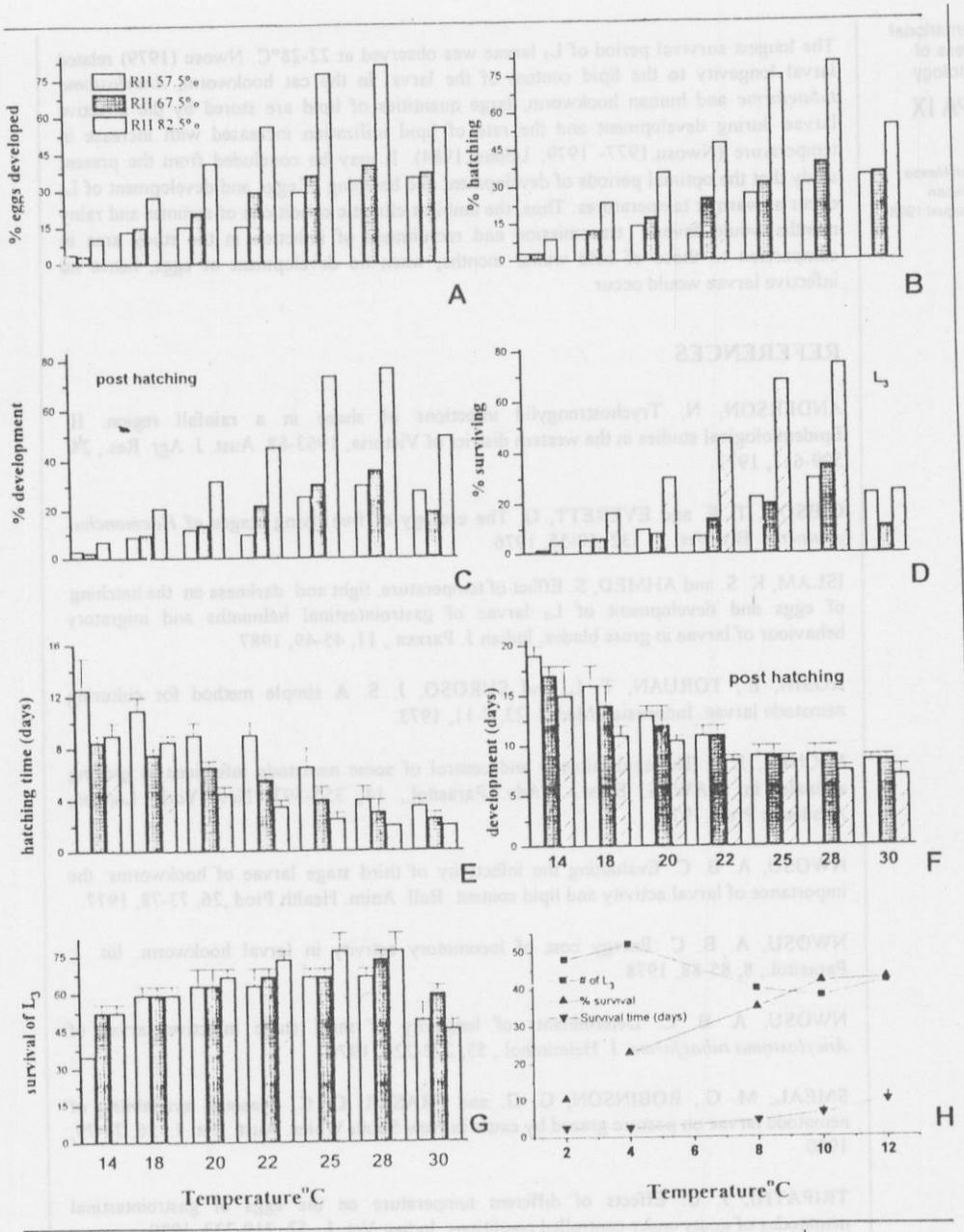
The effect of temperature and RH on the rate and time period of development and hatching of hookworm eggs, development and survival of L_3 larvae is depicted in figures A-H. The eggs incubated at <14°C did not complete their development and failed to hatch. The rate of development and hatching was found to be low (3%) at 14°C, RH 55-60% and maximum (81%) at 28°C, RH 80-85%. The time period taken for the eggs to develop and hatch at 14-18°C was found to be 8-10 days, but only 2-3 days at 22-28°C, RH 80-85%.

The rate of development and hatching was noted to be directly proportional to temperature and humidity till 28°C, beyond which a decline both in development and hatching rate was observed.

The L_3 filariform stage of larvae was observed in the culture between 8-9 days post hatching at 22-25°C, RH 80-85%. However, the time period of development to L_3 stage was prolonged to 9-12 days in the culture set at lower humidity. The rate of turnover of L_3 and their survival rate showed a rise with increase in temperature from 14-28°C but a decline, beyond 28°C. The developed L_3 larvae survived for a longer time, 70-84 days at 22-28°C but only 49-63 days at 14-18°C; at very low temperature (2-4°C) the larvae did not survive beyond 4 days.

DISCUSSION

From the present study it seems that temperature and humidity have marked effect on the development and hatching of hookworm eggs. Of the two factors, temperature played an important role, since at low temperature <14°C (corresponding to the cold winter temperatures of late November to early February) no development of eggs occurred even when the RH decreased or increased. Anderson(1973)observed that the rate of larval recovery of Trichostrongylus sp. increased gradually with increase of temperature. In the present study site the temperatures 14-18°C represent the ambient spring (late February to March) and autumn (September to early November) conditions and 22-25°C correspond to warm summer and rainy months (April to August). At higher temperature (30°C) the eggs took much less time in hatching, but the rate of hatching, survival of L_3 as well as their longevity declined compared to those incubated at 20°C. The optimal development temperature does not necessarily relate to larvae with highest larval longevity (Udonsi and Atata, 1987).



Figs. A-D. Rates of development of eggs, hatching, post-hatching development, and survival up to L_3 stage of hookworm at varying temperatures and relative humidity. [Approximately 200 eggs were kept at each incubation temperature and RH; the rates were calculated from the total number of eggs used]

Figs. E-G. Time (in days) taken for hatching, post-hatching development and survival of L_3 larvae at varying temperatures and relative humidity.

Fig. H. Number, rate and time period of survival of fully developed L_3 larvae at varying low temperatures.

The longest survival period of L_3 larvae was observed at 22-28°C. Nwosu (1979) related larval longevity to the lipid content of the larva. In the cat hookworm, *Ancylostoma tubaeforme* and human hookworm, large quantities of lipid are stored by the infective larvae during development and the rate of lipid utilization increased with increase in temperature (Nwosu,1977- 1979; Udonsi,1984). It may be concluded from the present study that the optimal periods of development and hatching of eggs and development of L_3 occur at warmer temperatures. Thus, the ambient climatic conditions of summer and rainy months would favour transmission and recruitment of infection in the study area in comparison to those of cold winter months, when no development of eggs, hence no infective larvae would occur.

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