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INFLUENCE OF TEMPERATURE ON HATCHING OF EGGS OF THE PESTIFEROUS SLUG *LAEVICAULIS ALTE* (FÉRUSSAC) (**)

Summary

The eggs of the pestiferous slugs *Laevicaulis alte* (Férussac) while maintained at room temperatures (19-35°C) and 10°C, 15°C, 20°C, 25°C, 30°C, 35°C constant temperature grades did not hatch at all at 10°C, 15°C and 35°C. The eggs required, on an average 20.92 ± 1.26 S.E., 17.15 ± 0.54 S.E. and 13.35 ± 0.31 S.E. days respectively at 20°C, 25°C and 30°C for hatching. The percentage of hatching varied with the temperatures: 89.4% at room temperatures, 81.6% at 30°C, 75.3% at 25°C and 72.6% at 20°C.

Sommario

Uova della dannosissima lumaca *Laevicaulis alte* (Férussac) vennero sia mantenute a temperatura ambiente (19-35°C), sia alle temperature costanti di 10°C, 15°C, 20°C, 25°C, 30°C e 35°C. Non si ebbe schiusa in quelle mantenute a 10°C, 15°C e 35°C costanti, mentre la schiusa avvenne dopo 20,92 ± 1,26; 17,15 ± 0,54 e 13,35 ± 0,31 rispettivamente per le temperature di 20°C, 25°C e 30°C. La percentuale di uova dischiuse varia con la temperatura: 89,4% nelle condizioni ambientali, 81,6% a 30°C, 75,3% a 25°C e 72,6% a 20°C.

Introduction

Temperature is considered as a critical environmental factor in the ecology of most organisms (Precht et. al., 1973; Wieser, 1973; Magnuson et al., 1979). It can act as both a trigger for the commencement of a biological process and as a threshold essential for its continuation. It may also influence the speed of developmental process.

Of the terrestrial molluscs, slugs are much sensible to temperature perhaps, because of shell-less. A good number of workers (Ricou, 1964; Mellanby, 1961; Godan, 1958; Dainton, 1954; Rising & Armitage, 1969; Segal, 1959; Blažka, 1955; Roy, 1963; Reichmuth & Fromming, 1961; Runham & Hunter, 1970) based on their observations, have concluded that certain aspects of slug's life-cycle are temperature dependent. Of these aspects, the role of temperature on the developmental process is limited only to *Milax budapestensis*, a member of slug community occurring in cold countries (Runham & Hunter 1970). However, report on this point on tropical and temperate slugs is still wanting. In the present study an attempt has been made to study the influence of temperature on the hatching of the eggs of the tropical pest slug *Laevicaulis alte* (Férussac).

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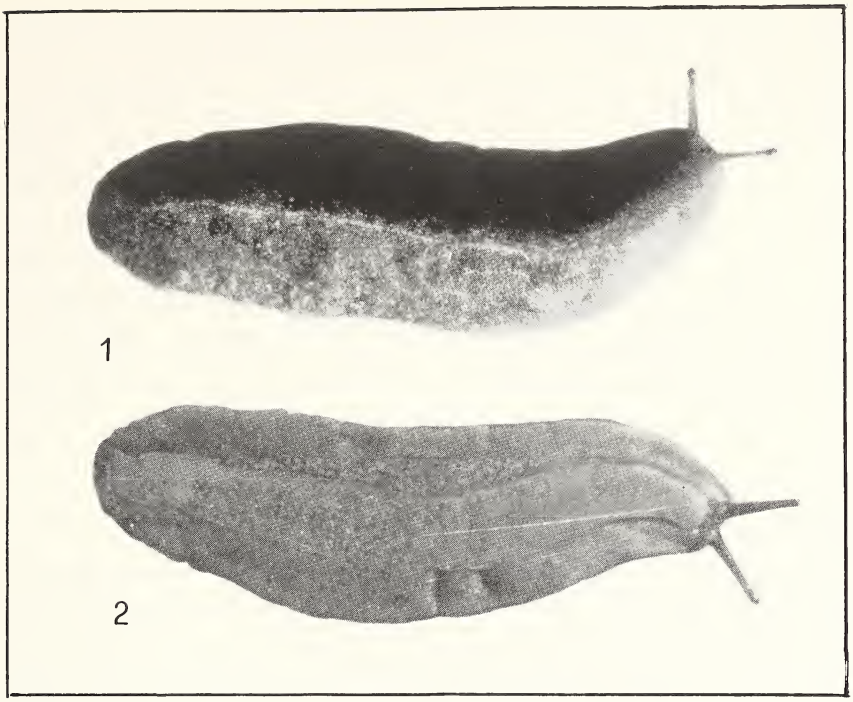
Materials and Methods

To have the eggs, on 6 June 1985, a good number of adult slugs *L. alte* were collected from their local habitat at Deulti, Howrah, West Bengal, India. They were maintained in a terrarium measuring 60 x 40 x 25 cm under laboratory condition. The terrarium was filled with loose, moist soil upto 10 cm of its height. Through regular water spraying the soils of the terrarium were kept moist. The favourable plant-foods viz. lettuce, potatoes, bean and gourd were supplied in excess regularly to the slugs. They started egg laying by the end of June 1985, and continued for more than one year. Subsequently, few more adult slugs were collected from the same habitat and cultured in the laboratory for obtaining eggs. Some of the egg-masses were kept as such in the terrarium for the study of hatching under room temperatures while a considerable number of egg-masses were transferred to B.O.D. (Biological Oxygen Demand) chambers (S.N. Mullick & Co., Calcutta) with 10°C, 15°C, 20°C, 25°C, 30°C and 35°C fixed temperature grades immediately after deposition, to note the length of developmental period of eggs. The egg-masses, as and when available during the period, 6 June 1985 to 24 November 1986 were selected for the studies. For experiments under each temperatures grade of B.O.D. chamber, a small wooden box measuring 20 x 15 x 15 cm was considered. The boxes were filled with loose soils upto 8 cm of its height. The favourable range of soil moisture was maintained through water spraying at a regular interval. Observations were made regularly to note the dates of starting and completion of hatching, and the number of eggs hatched.

In all experiments 40-45% soil moisture and 85-95% relative humidity were maintaned through spraying of water at certain intervals.

Results

The eggs of *L. alte* are oval and capsulated. In course of investigation a total of 4068 eggs belonged to 94 broods were considered (Table 1) for studies in different seasons of the period 6 June 1985 to 24 November 1986. The time required for hatching eggs and the percentage of hatching varied with the temperature grades (Table 1). Under room temperature which ranged from 19-35°C, the eggs started hatching on and from the 6th day following egg laying and continued for more than two weeks. No hatfhing was observed after 25th day of egg laying. In B.O.D. chambers eggs maintained at 10°C, 15°C and 35°C did not hatch at all. At 10°C and 15°C no development was noted even if, the eggs were maintained for a period of 4 months. But, at 35°C the eggs were damaged between 8th and 20th day following initiation of experiments. In most cases the eggs became decapsulated at this temperature grade. At 20°C, the eggs started hatching on the 11th day and completed on 36th day following the date of deposition. The eggs exposed to 25°C hatched between 10-24 days after laying. Hatching at 30°C was completed between 8-19 days. The average time required for hatching of eggs was minimum, 13.35 ± 0.31 S.E. days at 30°C. While at room temperature, at 25°C and at 20°C the same was next in order (Table 1). Though the eggs hatched at four different temperature grades the percentage of hatching was highest, 89.4, at room temperature and lowest, 72.6 at 20°C (Table 1).



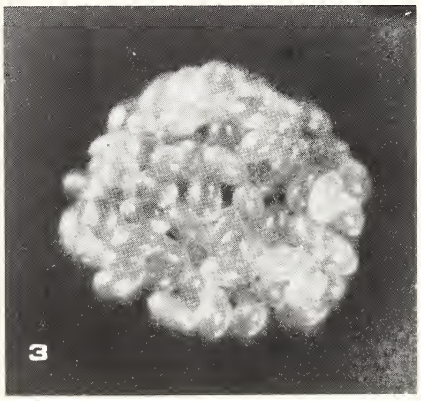


Fig. 1 - Dorsal surface of the slug *L. alte.*

Fig. 2 - Ventral surface of the slug *L. alte.*

Fig. 3 - Egg-mass of the slug *L. alte.*

Table 1. Length of developmental period and percentage of hatching of *L. alte* eggs exposed to different temperature grades.

Temperature (°C)	No. of broods taken	No. of eggs observed	Hatchability (%)	Length of hatching period (days)	
				Range	Mean±S.E.
Room (19-35)	16	604	89.4	6-25	15.56±0.75
10	15	617	—	—	—
15	12	566	—	—	—
20	12	508	72.6	11-36	20.92±1.26
25	13	617	75.3	10-24	17.15±0.54
30	14	641	81.6	8-19	13.35±0.31
35	12	515	—	—	—

Discussion

Since relative humidity and soil moisture were constant the results of the experiments suggest that the effect of temperature on the speed of development is considerable. It seems that temperatures little higher and lower than 30°C and 20°C are lettal for eggs of *L. alte*. As only 72.6% eggs were hatched, and they required 11-36 (average 20.92) days to complete development it appears that 20°C temperature is less favourable for hatching. Since with the gradual rise of temperature the developmental period decreased and the percentage of hatching was increased, it is apparent that higher temperatures accelerate hatching. On the contrary, the highest percentage of hatching noted at room temperature indicates that a fluctuating range between 19-35°C is more favourable for hatching than a fixed temperature grade within the said range. Though the eggs maintained at 20°C, 25°C and 30°C were hatched, a gradually high percentage of hatching at respective temperature grades has been noted. This suggests that a certain per cent of eggs are not able to maintain their physiological process for proper development of the embryos.

The eggs of European slug *M. budapestensis* hatched in about 3 weeks at 20°C, but took over 4 months to hatch at 7.5°C (Runnam & Hunter, 1970). From the present study, it is evident that the impact of temperature on the development of eggs is almost similar in both *L. alte* and *M. budapestensis* at 20°C. Though the eggs of *L. alte* failed to hatch at 15°C and low temperature grades, *M. budapestensis* eggs were succeeded in giving rise young ones after 4 months maintained at 7.5°C.

From the distributional record it is clear that *M. budapestensis* are confined to cold countries (Runham & Hunter, 1970) while *L. alte* are of tropical variety (Wallace & Rosen, 1969; Godan, 1983; Raut & Mandal, 1984). Obviously, they are adapted to their respective climatic conditions. As *L. alte* usually do not face temperatures below 15°C for hours together in their natural habitat during the breeding seasons it seems that constant exposure of such temperatures inhibits the physiological process of eggs.

Though no other report on this point is available it can be said that there must be a temperature grade like 20°C, as in *L. alte* and *M. budapestensis*, having almost equal influence on the length of development of eggs and percentage of hatching in most of the cold and temperate slug species. Studies on these points may prove helpful in determing the ancestral stalk of the slugs.

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