

Laboratory culture of *Diaphanosoma senegal* Gauthier, (Crustacea, Cladocera) from south India

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Abstract. Laboratory studies on growth and reproduction of *Diaphanosoma senegal* Gauthier show that this species has a life span of 18.7 days. Three preadult and sixteen adult instars were recorded at a temperature range of 28–30°C. Maximum body size is attained at the end of its life-cycle and the growth increment is more during preadult instars. The present observations are compared with other laboratory studies on tropical South Indian cladocerans.

Keywords. Growth; reproduction; *Diaphanosoma senegal*.

1. Introduction

The various members of the zooplankton, inspite of some convergent similarities, have different types of life history (Hutchinson 1967). According to Edmondson (1955), laboratory studies of the life span, instar duration, egg production and growth are valuable sources of information for zooplankton and secondary productivity studies. Earlier studies on some tropical species of Cladocera like *Moina micrura* Kurz (Murugan 1975a), *Ceriodaphnia cornuta* Sars (Murugan 1975b), *Scapholeberis kingi* Sars (Murugan and Sivaramakrishnan 1976) and *Daphnia carinata* King (Venkataraman 1981) from the freshwater ponds have shown some important intraspecific differences. Since differences in the life histories are likely to involve different relationships, it was felt that it would be of interest to study the growth and reproduction of *Diaphanosoma senegal* Gauthier under laboratory conditions (28–30°C), recorded for the first time in South India.

2. Material and Methods

Ovigerous females of *D. senegal* were collected from a seasonal pond near the University campus (Lat.: 9° 53' N; Long.: 78° E) and were acclimated to the laboratory temperature (28–30°C). Just born neonates were separated from the mothers and were reared in petridishes (50 ml) with pond water. The method used by Venkataraman (1981) was followed to study the life history. Table 1 shows the details of complete life-cycle on ten individuals.

3. Result

The body length of newly hatched *Diaphanosoma* which is a miniature form of adult in all respects measures about 0.59 mm. There are three preadult instars and sixteen adult

Table 1. Mean growth, egg number per brood and duration of instar of *D. senegal* at 28–30°C.

Instar number	Mean body size (mm)	Mean carapace size (mm)	Mean egg number	Cumulative frequency of eggs	Mean duration of instar(hr)	Cumulative duration of instar(hr)
1	0.59	0.20	—	—	13.2	13.2
2	0.88	0.26	—	—	18.8	31.0
3	1.22	0.33	—	—	23.8	54.8
4	1.37	0.45	3.2	3.2	37.3	92.1
5	1.47	0.49	2.6	5.8	25.6	117.7
6	1.53	0.52	2.9	8.7	23.7	141.4
7	1.56	0.52	2.8	11.5	23.5	164.9
8	1.63	0.55	3.0	14.5	24.0	188.9
9	1.70	0.55	3.5	18.0	23.2	212.1
10	1.73	0.55	2.6	20.6	21.6	233.7
11	1.73	0.59	2.7	23.3	23.4	257.2
12	1.76	0.59	2.8	26.1	23.6	280.7
13	1.76	0.59	2.6	28.7	24.8	305.5
14	1.79	0.59	3.0	31.7	24.1	329.6
15	1.83	0.59	2.2	33.9	24.3	353.9
16	1.86	0.62	1.3	35.2	23.2	377.1
17	1.86	0.62	3.0	38.2	22.6	399.7
18	1.89	0.62	2.3	40.5	24.0	423.7
19	1.89	0.62	—	40.5	24.0	447.7

instars. The body length of the first adult instar (4th instar) is 1.37 mm. An average maximum length of 1.89 mm is attained during the 19th instar and the mean life span is about 18.7 days (table 1). A comparison between the percentage of the preadult growth in relation to instar number of a few tropical and temperate cladocerans is shown in figure 1. It was observed that *D. senegal* has better preadult growth. The growth increment in relation to percentage of initial length and total length is shown in figure 2. Maximum number of eggs per brood of a single individual is 6 and the maximum cumulative frequency of egg production in a single individual is 56. The mean number of eggs produced and the cumulative frequency of egg production are shown in table 1. A comparison of egg production of a few tropical cladocerans in relation to instar number is shown in figure 3.

4. Discussion

The study shows that *D. senegal* has a total of nineteen instars (three preadult and sixteen adult) with an average life span of 18.7 days (447.7 hr) (table 1). The instar number of *D. senegal* is less than that of *Simocephalus acutirostratus* (22) and *Ceriodaphnia cornuta* (20), but greater than that of *Daphnia carinata* (18) and *Moina micrura* (13). These differences in the instar numbers may be due to hereditary factors as well as differences in the culture medium (Anderson and Jenkins 1942; Venkataraman 1983). The duration of instars in *D. senegal* varies throughout its life-cycle. Primiparous instar (4th instar, 37.3) is longer than the longest preadult instar (table 1). In this respect

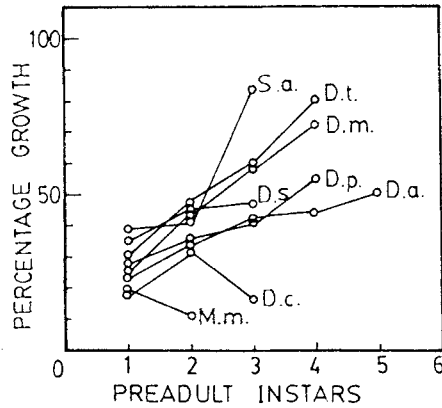


Figure 1. Percentage of preadult growth increment in relation to instar number of a few tropical and temperate cladocerans: S.a.— *Simocephalus acutirostratus*; D.t.— *Daphnia thomsoni*; D.m.— *Daphnia magna*; D.s.— *Diaphanosoma senegal*; D.p.— *Daphnia pulex*; D.a.— *Daphnia atkinsoni*; D.c.— *Daphnia carinata*; M.m.— *Moina micrura*.

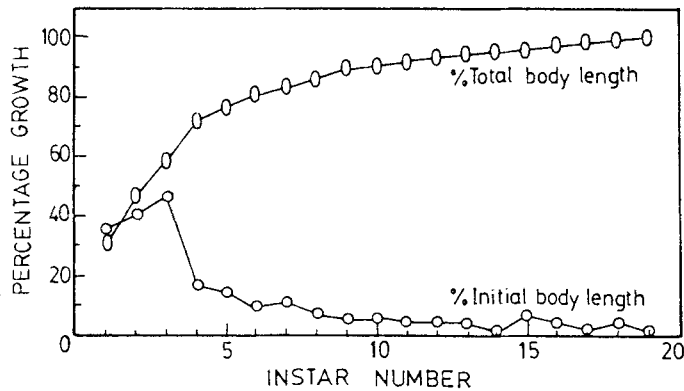


Figure 2. Growth increment as percentage of total body length and initial body length of *Diaphanosoma senegal*.

this species differs from *S. kingi* and *M. micrura* (Murugan and Sivaramakrishnan 1976; Murugan 1975a) where the duration of preadult and adult instars is uniform (24 hr) throughout their life cycle. *D. senegal* is similar to *S. acutirostratus* and *D. carinata* in having the longest preadult instar (Murugan and Sivaramakrishnan 1973; Venkataraman 1981).

Preadult growth increment as percentage of initial length of tropical and temperate cladocerans is shown in figure 1. The greatest growth increment does not always occur at the end of the adolescent instar or more rarely even earlier (Green 1955). In *D. senegal* the growth increment as percentage of initial length is 45.6% initially and reaches 71.6% at the 3rd instar (figure 2). From the 4th instar (adult instar) onwards the growth increment as percentage of initial length decreases suddenly. In the middle of its life span (at 10th instar) it attains 90% of growth (figure 2). The body length of *D. senegal* at the 4th instar is 1.37 mm. Comparison of preadult growth increment as percentage of

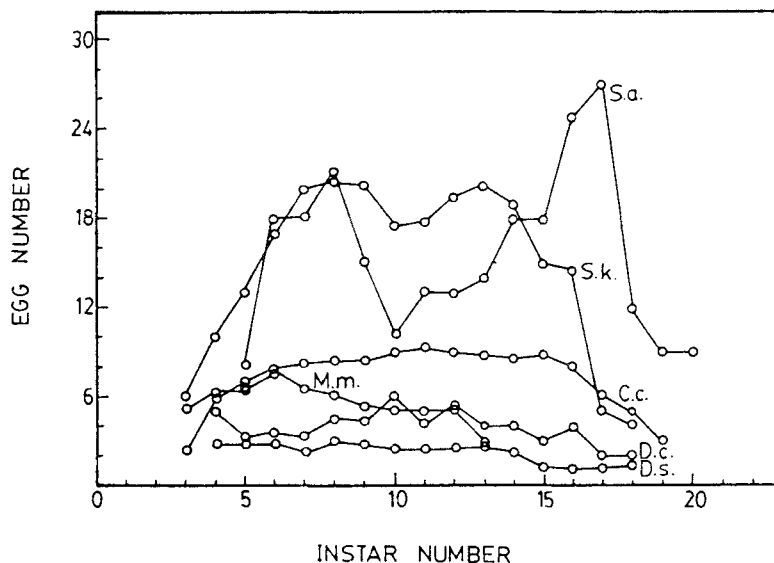


Figure 3. Egg production in relation to instar number of some tropical cladocerans: S.a.—*Simocephalus acutirostratus*; S.k.—*Scapholeberis kingi*; C.c.—*Ceriodaphnia cornuta*; M.m.—*Moina micrura*; D.c.—*Daphnia carinata*; D.s.—*Diaphanosoma senegal*.

initial length of a few temperate and tropical cladocera show that the temperate daphnids like *D. thomsoni*, *D. magna*, *D. atkinsoni* and *D. pulex* (Green 1955) have the greatest growth increment during the preadult instar. *S. acutirostratus* (Murugan and Sivaramakrishnan 1973) attains maximum growth increment in the 3rd preadult instar (84%) and this is the highest growth increment reported in any temperate or tropical species. *M. micrura* on the other hand shows minimum growth increment during the preadult instar and it recovers its growth only during the adult instars (Murugan 1975a). A study of *D. senegal* reveals that the highest rate of growth increment is seen during preadult instar 3 (45.6%).

Progressive increase in body size is a measure of growth rate of the individual (Edmondson 1955). The mean growth increment of *D. senegal* is rapid during the earlier phase and is very slow during the reproductive phase. Rapid preadult growth increment seems to be a common feature for Cladocera irrespective of physiological and physicochemical factors (Venkataraman 1983). The growth pattern of *D. senegal* shows a s-shaped curve. According to Hutchinson (1967) the growth rate per instar is always correlated with food supply, but growth pattern studies of *D. senegal* in relation to food or temperature has not been made.

The mean number of eggs per brood in relation to instar number of *D. senegal* is compared with a few tropical South Indian cladocerans (figure 3). The maximum number of eggs per brood under laboratory conditions (28–30°C) of a single individual is 6 and the total number of eggs produced in a life span is 56 (maximum number). Comparative study of egg production of tropical South Indian cladocerans under the same conditions reveals that *S. acutirostratus* (Murugan and Sivaramakrishnan 1973) produces the maximum number of eggs per brood (27) when compared to other tropical Cladocera. *D. senegal* produces a lesser number of eggs per brood, with a maximum of 3.5 eggs at the 9th instar (figure 3). The variation in egg

production in the species of Cladocera can be attributed to the amount of food available for the organism during its life span (Dunham 1938; Anderson and Jenkins 1942), temperature of the culture medium (Mc Arthur and Baillie 1929), and genetic makeup of the animal (Banta and Wood 1939).

An interesting aspect of this study is the record that *D. senegal* produces sexual eggs. The parthenogenetic eggs of *D. senegal* are oval but the sexual eggs are white in colour. The egg is covered by an outer leathery coat. When the eggs are dried, the outer shell shrinks and floats but when wet they sink to the bottom. The sexual eggs are entirely different from those of *D. carinata* which have a black, thick chitinous outer coat.

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