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GROWTH CHARACTERISTICS OF CERTAIN ESTUARINE PHYTOPLANKTERS

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ABSTRACT

The growth constants, mean generation time, chlorophyll in relation to cell numbers and ^{14}C uptake have been studied in a few unialgal cultures of selected phytoplankters isolated from Cochin backwaters. Highest growth constant and lowest mean generation time are obtained during the exponential growth phase. The changes taking place in the growth kinetics on varying concentrations of essential nutrients have also been incorporated.

INTRODUCTION

A study on the growth characteristics of the phototrophic unicellular algae is very helpful to solve some intricate problems encountered in field studies on primary production. With such a view, several unicellular algae have been isolated from inshore, offshore and estuarine environment where the productivity studies are concentrated. The isolated species maintained in suitable media are also used as a food for the producers at higher trophic levels. These algae inoculated in a limited volume of the medium proliferate in a characteristic pattern consisting of a lag phase, exponential phase, declining phase and a death phase cf. Fig. 1. The rate of metabolic activities of the algae varies with the phases and the length of the phase is influenced by the age, volume of the inoculam, nutrient concentration and light intensity. Investigations have been carried out on the growth characteristics of several species of algae such as *Chlorella pyrenoidosa* (Fogg and Belcher, 1961), *Asterionella formosa* (Lund, 1949), *Asterionella japonica*, *Isochrysis galbana*, *Prorocentrum micans* (Kain and Fogg, 1960), *Phaeodactylum tricornutum* (Spencer, 1954; Raymont and Adams, 1958). Many of these studies have been directed towards an elucidation of environmental influence on population (cf. Braarud, 1961) *viz.*, the reaction of each species to specific environmental conditions. The mean generation time, (tg) and relative growth constant (k) have been studied for several phytoplankton species

(Strickland, 1960; Fogg and Belcher, 1961; Fogg, 1965). The specific growth constant 'k' depends on the species and even the races within the species and environmental factors. This study forms a supplement to the observations on *Tetraselmis gracilis* (Joseph *et al.*, in press).

Material and Method

Three species *Thalassiosira subtilis*, *Tetraselmis gracilis* and *Synechocystis salina* collected from estuary, inshore and offshore regions respectively were selected for the present study. *Thalassiosira subtilis*, of Bacillariophyceae collected from the estuary at salinity 20 ‰ and *Tetraselmis gracilis*, a green flagellate and *Synechocystis salina* of Cyanophyceae collected from salinity of 32 ‰ were grown in media (Miquel's modified by Ketchum and Redfield, 1938) having the corresponding salinity. One week old actively growing cells of *Thalassiosira subtilis* and *Synechocystis salina* were inoculated into two separate flasks each containing media of two different salinity, their initial concentrations being 220 and 510 cells/ml respectively. Several experiments were carried out using *Tetraselmis gracilis*, their initial concentrations varied from 200 to 1700 cells/ml. These cultures were grown in diffused day light at room temperature under aeration. Aliquots of the culture were taken every alternate day to measure the organic production by C^{14} technique. Cell counts were taken with haemocytometer. Activity of filter was determined on a Geiger Counting System (Electronics Corporation of India) having a counting efficiency of 3.2%.

Growth Rate

The three species showed different trends in growth - in the length of each phase, in generation time and growth constants. In Miquel's medium (modified) *Tetraselmis gracilis* from an initial concentration of 200 cells increased to 1000 cells/ml by the second day and then to 30,000 cells on the third day. By the fifth day, the concentratiou reached 100,000 cells/ml. The highest K value of 0.07 (hours) -1 was obtained on the third day when the mean generation time t g was 10 hours. (Fig. 2). From then on, the growth trend of the culture was followed for about a month. Though apparently no senecence was noticed, there was a steady decrease in the K value and a progressive increase in the mean generation time t g. The K value dropped to 0.01 (hours) -1 by the 25th day and thereafter continued at this level till the 35th day when the mean doubling time was 70. The growth constants and mean generation time were also calculated from carbon production. The lowest generation time obtained is 37 and the corresponding value (*i. e.*, the highest K value) is 0.019 (hours) -1. On the third day while the cell counts give the generation time 10 hours production value shows generation

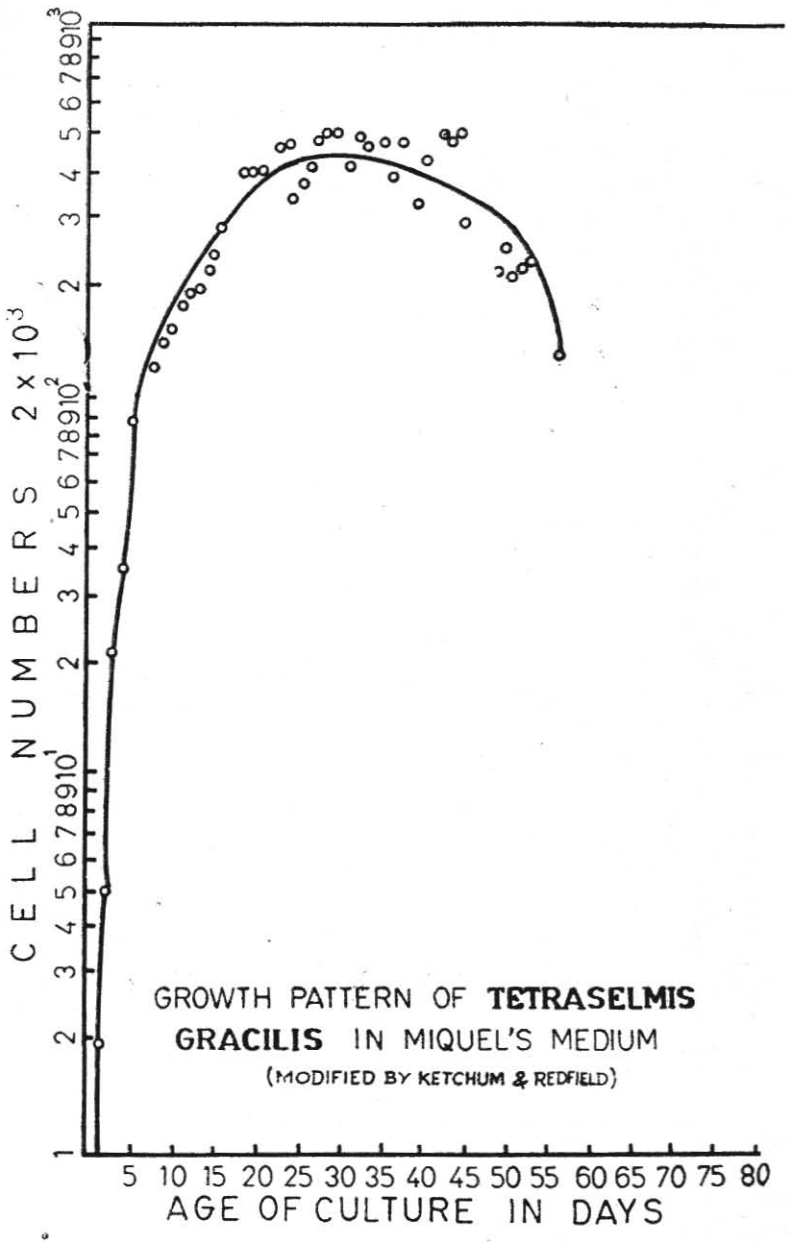

Fig. 1 Growth pattern of *Tetraselmis gracilis* in Miquel's medium (modified by Ketchum and Redfield).

time as 37. The tg value for a similar Chlorophycean flagellate *Dunaliella euchlora* is 12 hours (McLeod, 1957). As the culture grew old there was a steady increase in the tg value and corresponding decrease in the growth constant. On the 15th day the generation time showed by carbon production was 70, it was only 32 for cell counts. The corresponding K values are 0.010 and 0.022 (hours) -1. On the 25th day the K value dropped to 0.004 (hours) -1 as evidenced by carbon production, taking 175 hours for doubling and thereafter continued at this level till the 35th day. K value on the 25th day was 0.014 as shown by the cell multiplication and the corresponding generation time was 50 hours. Thereafter there was a steady decrease and corresponding increase in generation times. Thus on the 35th day the growth constant was 0.010 time (hours) -1 and mean generation time was 70 hours.

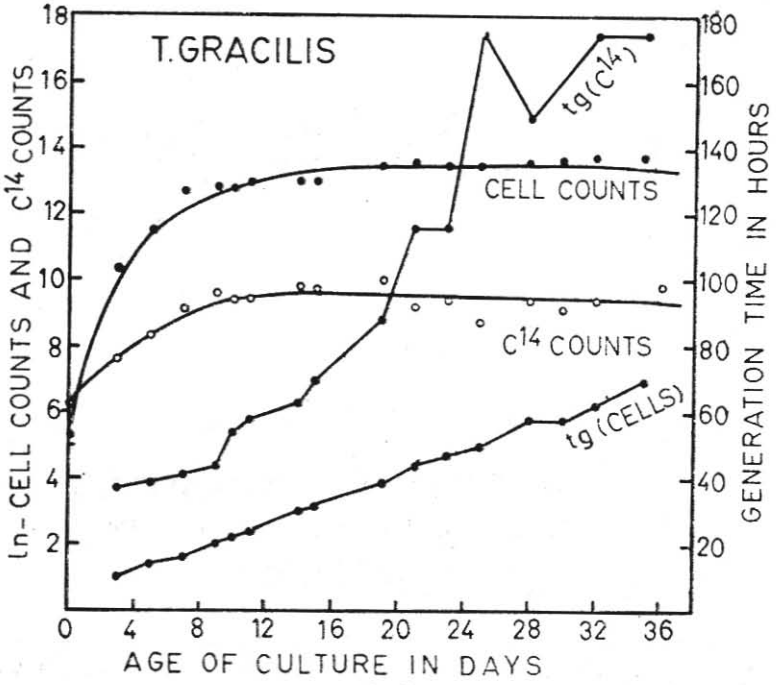

Fig. 2 Growth trend and generation time of *Tetraselmis gracilis*.

In unenriched sea water the lowest generation time obtained was 50hours *i. e.*, on the 4th day, the growth constant being 0.014 (hours)-1. During the two weeks observation the growth constant dropped to 0.004 (hours)-1 on the 10th day indicating a mean generation time of 175 hrs. While 10μg at PO_4-P/1 was added there was a slight increase in the growth constant from 0.014 to 0.022 (hours)-1 giving a mean generation of 32 hrs. Here the lowest growth constant and the highest mean generation time were 0.007(hours)-1 and 100 hrs. (8th day) respectively as against 0.004 (hours)-1 and 175 hrs. (10th day) in the unenriched sample. When both 10μg at PO_4 - P/L and 10 μg at NO_3 - N/L were added the growth condition improved further (Fig. 3). On the second day the growth constant was 0.043 (hours)-1 and mean doubling time 16 hours. The lowest growth constant 0.012 (hours)-1 was recorded on the 14th day with a mean generation time of 58 hours.

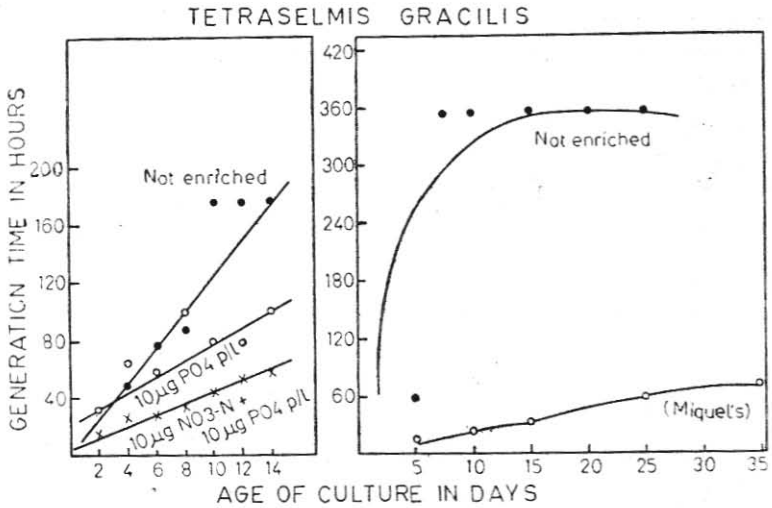

Fig. 3 (a) Effect of phosphate and nitrate on generation time in *Tetraselmis gracilis.*

(b) Generation time of *Tetraselmis gracilis* in enriched and non-enriched medium.

Thalassiosira subtilis from an initial concentration of 220 cells/ml on the second day reached 220000 cells/ml on the 10th day. The highest growth constant of 0.056 (hours)-1 was recorded on the second day and the corresponding lowest generation time was 13 hours as shown by the cell multiplication (Fig. 4). The lowest growth constant and the highest generation time obtained during this period were 0.029 (hours)-1 and 24 hours respectively.

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