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THE INFLUENCE OF LIGHT ON THE GROWTH AND PIGMENT COMPOSITION OF *HYPNEA VALENTIAE* (TURN.) MONT.

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ABSTRACT

The female gametophyte of *Hypnea valentiae* (Turn.) Mont. collected in the backwaters of Muttukadu near Madras was investigated under different light intensities ranging from 2 to 80 $\mu Em^{-2}s^{-1}$ under laboratory conditions. Growth was maximum under 50 μ $Em^{-2}s^{-1}$ light intensity. Higher light intensities did not favour the growth and photosynthetic pigments such as Chl *a* and PE, however, the amount of PC and APC was more under these light intensities. Growth was poor under lower light intensities despite these light intensities promoted the accumulation of photosynthetic pigments.

Key-words : *Hypnea valentiae*, light intensity, growth, pigments.

Hypnea spp. are well known for their phococolloid *k*- carrageenan and other compounds of pharmaceutical interest (Rama Rao, 1982; Davies, Jamieson, Baird-Lambert and Kazlauskas, 1984). Light intensity is one of the most important factors governing growth and productivity of seaweed communities. Increased shading usually leads to slow growth and abnormally small plants (Buggeln, 1974; Philips and Mitsui, 1982). Higher light intensities promoted the widening of lamina in *Laminaria saccharina* (Burrows, 1961). The light intensity not only affected growth but also photosynthesis, pigment composition and carrageenan yield and quality (Yocum and Blimks, 1958; Brody and Emerson, 1959). In the present study an attempt was made on the effect of different light intensities on *Hypnea valentiae* (Turn.) Mont. (Gigartinales, Rhodophyta).

Specimens of the cystocarpic plants of *H. valentiae* collected in the backwaters of Muttukadu near Madras during July 1990 were brought to the laboratory, washed thoroughly in filtered seawater and epiphytes were removed. Then the thalli were cultured in sterilized f/2 medium (Guillard and Ryther, 1962), 50 $\mu Em^{-2}s^{-1}$ light intensity, 24 $\pm$ 1 °C and 12/12 light - dark cycle. The contaminants such as diatoms and blue - green algae were eliminated (Rengasamy, Prema, Govindarajan and Ilanchelian, 1987). Algal samples were kept under the following light intensities viz., 2, 10, 20, 30, 40, 50 (control), 60 and 80 $\mu Em^{-2}s^{-1}$. Initially the different light intensities were measured using the lux meter (EEL portable photoelectric photometer) and then, the values converted into $\mu Em^{-2}s^{-1}$ according to the equation No. 10 (Luning, 1981). Cultures grown under laboratory conditions for a period of one month were used as inoculum. For each experiment 80 mg of eight apical portions were used as initial inoculum in 100 ml flask containing 50 ml of medium. Medium was replenished every three days of interval (Mshigeni, 1978). The following data were recorded at the end of 15th day: (a) fresh weight (mg) and (b) photosynthetic pigments such as Chl *a* (Jaffery and Humphery, 1975; Ramus, 1983) and the accessory pigments such as PE (Phycoerythrin), PC (Phycocyanin) and APC (Allophycocyanin) (Kursar, Van deer meer and Alberte, 1983). Triplicates were maintained for each experiment. The values of the photosynthetic pigments were expressed as µg/mg fresh wt.

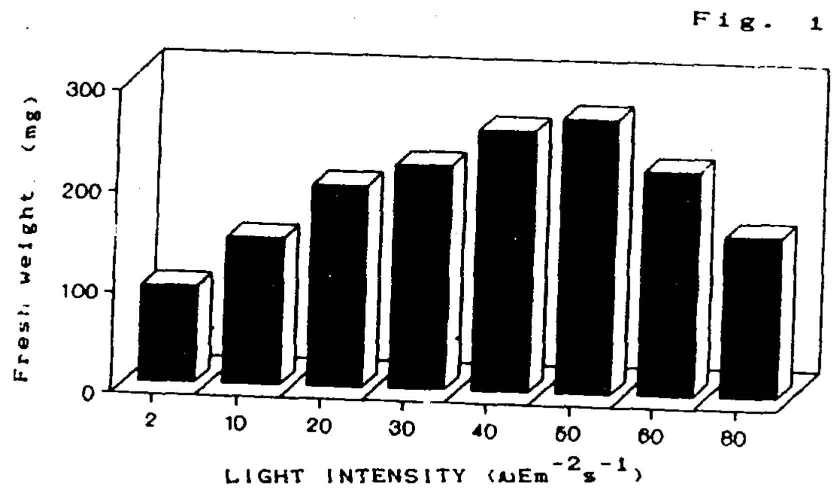

Fig. 1. Effect of light intensity on the growth of *H. valentiae*

H. valentiae showed growth in all light intensities. Maximum fresh weight of 270 mg was recorded at 50 $\mu Em^{-2}s^{-1}$ (control) light intensity. Light intensities above control affected the growth of *H. valentiae*. At 80 $\mu Em^{-2}s^{-1}$ light intensity, the algal fresh weight was 158 mg, which was lesser than 42% to that of control. Lesser growth was observed under the intensities below control. Minimum fresh weight of 97 mg was recorded at 2 $\mu Em^{-2}s^{-1}$ (Fig. 1). The following values on the photosynthetic pigments were recorded in control viz., 0.12 µg/mg Chl *a*; 0.67 µg/mg PE; 0.2 µg/mg PC and 0.28 µg/mg APC. Lower light intensities favoured the accumulation of photosynthetic pigments in contrast to a given period for growth. At the lowest light intensity (2 $\mu Em^{-2}s^{-1}$) the amount of photosynthetic pigments was 0.35 µg/mg Chl *a*; 0.74 µg/mg PE, 0.50 µg/mg PC and 0.34 µg/mg APC which were more than 190%, 10%, 150% and 20% respectively when compared to control. Higher light intensities (above control) did not favour the production of Chl *a* and PE but favoured the production of PC and APC. At 80 $\mu Em^{-2}s^{-1}$ the amount of Chl *a* and PE were 0.80 µg/mg and 0.50 µg/mg which were lesser than 33% and 26% respectively to that of control. However the amount of PC and APC was 0.26 µg/mg and 0.40 µg/mg which were more than 30% and 33% respectively to that of control (Fig. 2.)

Phycologist recognised that growth and colour of a red alga may vary depending on the depth at which it is growing or the intensity of exposure to the sun light (Waaland and Cleland, 1972). Gantt and Lipschultz (1973) proposed that the light energy absorbed by phycoerythrin is transferred down a chain through phycocyanin to allophycocyanin and finally to membrane bound chlorophyll. Growth of *Gracilaria* increased linearly with increasing light to 0.43 doublings d^{-1} at high light levels (Goldman, 1979). In the present investigation *H. valentiae* preferred to show its maximum growth at 50 $\mu Em^{-2}s^{-1}$. Light intensities above 50 $\mu Em^{-2}s^{-1}$ affected the growth of the alga. *H. valentiae* grew slowly under lower light intensities for a given period of time.

Fig. 2

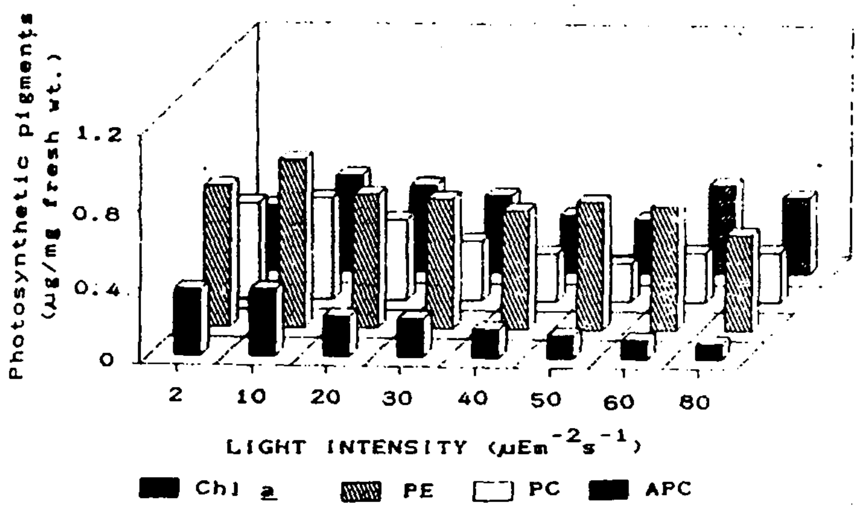

Fig. 2. Response of photosynthetic pigments to light intensities.

Pigment levels are affected by different light intensities (Beale and Appleman, 1971; Durbin, 1974; Ramus, Beale and Mawzerall, 1976). The ratio of accessory pigments of Chl *a* was controlled by light intensity in the red alga *Griffithsia pacifica* (Waaland and Cleland, 1972). The total accessory pigments extracted from *Neoagardhiella baileyi* exhibited 86% PE, 7% PC and 6.9% APC (Kursar, Van deer meer and Alberte, 1983) and *Gelidiopsis variabilis* showed 78% PE, 14% PC and 8% APC under 1500 lux intensity (Rengasamy and Prema, 1986). In the present study the accessory pigments of *H. valentiae* under control showed 58% PE, 17.4% PC and 24.3% APC. Laponite (1981) observed in *Gracilaria foliifera* v *angustissima* that the chlorophyll *a* and phycoerythrin contents were inversely proportional to light intensity level and growth rate. *Griffithsia pacifica* while grown at 40 to 50 ft. c. (lower light intensity) had twice as much phycoerythrin/chlorophyll *a* (µg/mg) as plants grown under 300 ft. c. (higher light intensity) (Waaland and Cleland, 1972). In the present investigation also an inverse correlation was observed between growth and pigments under lower light intensities. Higher light intensities did not favour growth as well as photosythetic pigments such as Chl *a* and PE but enhanced the production of PC and APC. The reduction of Chl *a* at higher light intensities was due to photo-oxidation of the chlorophyll (Ramus, Beale and Mawzerall, 1976). The increase in the contents of PC and APC may be useful for protecting Chl *a* from higher light intensities.

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