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Original Research Paper

The Impact of Monochromatic Light on the Growth and Pigment Production of *Cladophora crispata* (Chlorophyceae)

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ABSTRACT

The effect of monochromatic light, red, yellow, green and blue has been studied on the cultures of *Cladophora crispata* against white and total darkness with reference to the growth, morphological variation and pigment changes. Maximum growth was observed under white light. Red light favoured the growth while blue light and darkness retarded totally its growth.

INTRODUCTION

Earlier monochromatic lights have been extensively used on various algal members for studying their photosynthetic activity and spore formation. Recent studies with monochromatic lights have concentrated on the growth, morphological variations and reproduction of varied algal members (Vidyavati & Nizam 1975, Vidyavati 1977, Ahulwalia & Kumar 1980, Agarwal & Sarma 1982, Srivastava & Nizam 1984, Nagaraju & Vidyavati 1984, Dadhech & Srivastava 1988, Vidyavati & Digamber Rao 1989, Singh & Chaudhary 1990 and Blessina & Vidyavati 2002). The present paper deals with the influence of monochromatic lights on the growth and chlorophyll pigment production of *Cladophora crispata*.

MATERIALS AND METHODS

Cladophora crispata was collected from the freshwater pond of Ippagudem, Ghanpur mandal in Warangal district of Andhra Pradesh and maintained in Godward's medium fortified with 10% (1: 1) garden soil extract (Pringsheim 1946) under controlled culture conditions. The cultures were kept under 16 hours light and 8 hours dark period at a temperature of 22 ± 2°C at pH 7.5.

Approximately 5 mg of the alga (on fresh weight basis) was inoculated in the test tubes with 15 × 150 mm capacity containing 15 mL of sterilized culture medium. Two sets of culture tubes were subjected to different illumination of visible light for a period of 40 days.

Different qualities of visible spectrum were obtained by wrapping the culture tubes with best quality of variously coloured cellophane papers (Nagaraju & Vidyavati 1984) and exposing them along with controls (white) by cool white fluorescent tubes light. The distance from the illumination source was kept constant for all the culture tubes (18 cm) under study.

A parallel set of culture tubes was put in total darkness in order to see the effect of continued darkness. Two sets of culture tubes were used among which, one set was mainly used for the pigment analysis, and the other, exclusively for survival percentage. Observations were carried out on every 8^{h} day for a duration of 40 days. Cultures were shaken twice to thrice a day in order to avoid clumping filaments.

For percentage of survival from each culture tube, 20 slides were prepared and from each slide 20 randomly selected fields of view were scored under the compound microscope and observations were made. In addition to this, pigments were also extracted from all the samples. From each sample 20 mg of the material was taken and grinded with 10mL of 80% acetone. The solution was centrifuged and supernatant was carefully transferred into another test tube. The separated solution was used for the absorption spectra from 645 mµ to 663 mµ by using a spectrophotometer.

The present content of total chlorophyll, chlorophyll '*a*' and '*b*' were calculated separately, by using the formulate of Maclachlan & Zalik (1963) as mentioned by Holden (1976) on fresh weight basis.

White light: The maximum growth was observed at the end of 24 days and later it was found to be declined gradually. The chlorophyll-*a* contents were higher than chlorophyll-*b* in all the samples. It was interesting to note that in white light illumination the chlorophyll-*b* was higher (1.40 mg/g) than chlorophyll-*a* (1.10 mg/g). The chlorophyll contents were observed to be approximately the same under white and red illumination conditions under the study. However, there was very meagre difference in yellow and blue lights under the investigation.

Red light: The healthy appearance of filaments in these cultures was observed up to 16 days. Growth of filaments was retarded gradually after 24 days. The subsequent observations revealed that abnormal filaments with unhealthy pigments granulated, condensed and contraction of the chloroplasts were observed after 32 days. The change of pigmentation of the cultures under red light was declined when compared to the white light (Table 1).

Yellow light: Eight days exposure to yellow light has not only resulted in a diverse range of abnormality but also reduced the healthy green chlorophyll to pale-yellow colour. The growth was also reduced gradually. The values of pigment content also showed a slight decrease during the entire period of 40 days. The the growth was almost reduced to half when compared to white light under observation.

Green light: The growth rate was too slow and it has followed next to yellow in descending order. The cultures comprised of a good number of dead and unhealthy cells which were observed after 32 days and all the cultures turned yellowish. The chlorophyll content was maximum (0.65mg/g) on 24th day as compared to other days.

Blue-light: In blue light, the chloroplast showed maximum damage resulting in the marked retardation of growth. The cultures could hardly survive for 24 days under this exposure and very few healthy cells were recorded by the end of 16 days. Cultures turned pale-yellow and there was no visible sign of any growth after 32 days and pigment content values also gradually decreased by 8th day itself.

Total darkness: The cultures of *Cladophora crispata* grown under total darkness, suffered almost similar manifestations as recorded in the case of cultures subjected to blue light. Cultures were found to be unhealthy on first observation itself. After 24 days cultures turned completely white and totally found with dead filaments. Pigment content of cultures in darkness were found to be less than that of other treatments.

RESULTS AND DISCUSSION

Growth and chlorophyll pigment production of *Cladophora crispata* varied significantly under the influence of monochromatic lights. The optimum growth was obtained under white and red light, whereas, under yellow, green, blue and darkness, the growth was inhibited totally. Red light, invariably promoted the growth of *Cladophora crispata,* while the growth was very much suppressed under the blue light. This observation gets its support from the findings of Klugh (1925) on *Closterium* and *Volvox*, Karlander & Krauss (1962) on *Chlorella,* Abbas & Godward (1963) on *Stigeoclonium*, *Draparnaldia*, and the members of desmids (Vidyavati & Nizam 1975, Vidyavati 1977, Nagaraju & Vidyavati 1984 and Srivastava & Nizam 1984).

In dark light, growing cells were found with bulging cells before disintegration. Thomspon et al. (1985) in their work concluded that the darkness exhibited lethality in *Chlamydomonas reinhardtii* was due to swelling and malformation of cells, but it was not the result of insufficient energy supply. During the present study, sudden drop in the number of healthy cells was recorded in the cultures subjected to total darkness.

Previously, Vidyavati & Digamber Rao (1989) have reviewed the effect of monochromatic lights on different algal members. Singh & Chaudhary (1990) investigated the effect of different nutrient media and qualities of light on the induction of oogonium in *Oedogonium hatei.* Blessina & Vidyavati (2002) have also observed the impact on monochromatic illumination on *Rhizoclonium* sp.

Previous results support the present investigations in all the aspects of study. Data obtained from percentage survival

Table 1: Chlorophyll content mg/g of *Cladophora crispata* after monochromatic illumination.

Quality of light	8 days			16 days			24 days			32 days			40 days		
	Chlorophyll content			Chlorophyll content			Chlorophyll content			Chlorophyll content			Chlorophyll content		
	a	*b*	Total	*a*	*b*	Total	*a*	*b*	Total	*a*	*b*	Total	*a*	*b*	Total
White	1.05	1.02	2.07	1.01	0.96	1.97	1.1 0	1.4 0	2.50	1.15	0.97	2.12	1.1 0	0.71	1.81
Red	1.25	0.61	1.86	1.24	0.72	1.96	1.1 0	0.71	1.81	1.01	0.73	1.74	0.96	0.66	1.62
Yellow	0.64	0.32	0.96	0.32	0.32	0.64	0.6 0	0.3 0	0.9 0	0.42	0.4 0	0.82	0.41	0.28	0.69
Green	0.35	0.3 0	0.65	0.42	0.28	0.7 0	0.37	0.28	0.65	0.31	0.25	0.56	0.29	0.19	0.48
Blue	0.36	0.27	0.63	0.31	0.25	0.56	0.33	0.22	0.55	0.22	0.24	0.46	0.22	0.21	0.43
Total dark	0.32	0.28	0.6 0	0.3	0.22	0.52	0.29	0.2 0	0.49	0.22	0.21	0.43	0.16	0.11	0.27

and pigment content of the cultures subjected to total darkness revealed that without light, the cells could not survive and hence, it may be established that light is an essential factor for the biological functions of algae.

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