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CTENOCLADUS CIRCINNATUS BORZI FROM GUJARAT, INDIA[1]

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ABSTRACT

Ctenocladus circinnatus Borzi along with *Riella* from Lake Nal in Gujarat was collected for the first time in India. Morphological characters of the alga were studied from the plants grown in liquid medium and on agar in natural light and artificial/reversed light (12 hours light and 12 hours dark) at room temperature and 22°C respectively. Karyological study of *Ctenocladus* is described for the first time and the chromosome number is estimated to be 12.

INTRODUCTION

Since the establishment of rare, green, monotypic alga, *Ctenocladus* by Borzi (1883), there is no report of its occurrence from India. It has a limited distribution, being restricted to saline environments (Smith, 1950; Prescott, 1970; Blinn, 1970; Blinn and Stein, 1970). Borzi collected *Ctenocladus circinnatus* as an epiphytic alga on *Salicornia* sp. and *Ruppia* sp. in saline habitat in Sicily. Woronichin and Popova (1929) collected the same type of plant from Siberia. As the plant possessed greater resemblance with *Lochmium*, in having more akinetes and intercalary zoosporangia, they named it as *Lochmiopsis* and described two species, *L. siberica* and *L. printzii*. A third species, *L. chodatii* was added by Printz (1964). Later on *Lochmiopsis* and *Ctenocladus* were combined and the original name *Ctenocladus* was retained by Smith (1950) and Bourrelly (1966).

The plant is rare and important for its taxonomic position. As the karyological study had not been carried out so far, it was selected for the present studies (Abbas and Godward, 1964; Godward, 1966; Sarma, 1973).

The present material was collected from Lake Nal (Nal Sarovar), Gujarat, about 77 km, SW of Ahmedabad. The lake covers nearly 182 km, most of it under water all the year round and becomes brackish in summer. The geographical and geological data have been given by Patel and Asoka Kumar (1971) and Patel (1977).

MATERIALS AND METHODS

Ctenocladus circinnatus Borzi was found along with *Riella cossoniana* Trab., one of the rare Bryophytes, which was growing in shallow water near the margin of Lake Nal in the last week of December, 1975. Some of the plants of *Riella* were put in the petridishes containing tap-water and were allowed to grow in natural light at room temperature. After 15 days, *Ctenocladus* was found growing as few-celled patches attached at the bottom of the petridishes. Within a week, these few celled plants became free floating on the surface of the water. Some of these plants were transferred in the petridishes containing Godward's culture solution (Godward, 1942) and were allowed to grow in natural light at room temperature.

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Another set was put in the same way in the petridishes containing 'hard agar medium' prepared in culture solution for *Riella* as suggested by Proskauer (1955). A third set was prepared as above in 'hard agar medium' and was put in artificial light (12 hours light and 12 hours dark) at 22°C in an illuminated cooled Gallen Kemp incubator.

For the cytological studies, the material was fixed in 3 : 1 (Ethyl alcohol: acetic acid). Acetocarmine squash method was applied for staining and study.

OBSERVATIONS

The growth of *Ctenocladus* was very slow in Godward's culture medium. It was better in artificial light at 22°C in the incubator, compared to the plants kept in natural light at room temperature.

Morphology: Plate I, Figs. 1-20.

Erect filaments developed after a week in the culture. Different stages of development are shown in Figs. 1-7. It took about two months for fully mature plants to develop. Branching is unilateral, arising sometimes at right angles to the main filaments (Fig. 8). Sometimes, the filaments showed bridge-like connections of cells between two neighbouring filaments (Fig. 20). Occasionally, the filaments became biseriate in certain cases (Fig. 16). The cell is uninucleate with laminate chloroplast and 2-3 pyrenoids in it. Young cells are cylindrical, $1\frac{1}{2}$ to 2 times as long as broad. Vegetative cells are 6.0-17.0 μm long and 5.6-8.5 μm broad.

Terminal and intercalary cells produced biflagellate zoospores. 4-8 zoospores were found in a cell (Figs. 9-10). They were liberated by the rupture of parent cell walls (Fig. 10). They are 9.7-11.7 μm long and 5.2-7.2 μm broad. They settled down at the bottom of the petridishes and germinated into new plants (Figs. 12-15). Akinete-formation, characteristic of the genus, took place after a week of zoospore-formation. They are spherical to sub-spherical, developed terminally or intercalary, single or in rows of 2-5 (Figs. 16-20). They are 10.0-14.0 μm in diameter. Germination of akinetes into new plants was seen *in situ*. Sexual reproduction was not observed in the species.

The plants survived for about three months in the cultures.

Cytology: Plate II. Figs. 1-2.

Interphase nuclei are spherical measuring 1.7 to 2.6 μm in diameter. It contained a single nucleolus with one or two stained bodies. Chromatids of individual chromosomes were not seen at any stage of prophase. Metaphase plates in polar view are 2.6 μm in diameter. The chromosome number was estimated as n=12 from number of metaphases. Figs. 1 & 2 show 12 chromosomes. Being small chromosomes, position of centromeres and the morphology of chromosomes could not be studied in the present species.

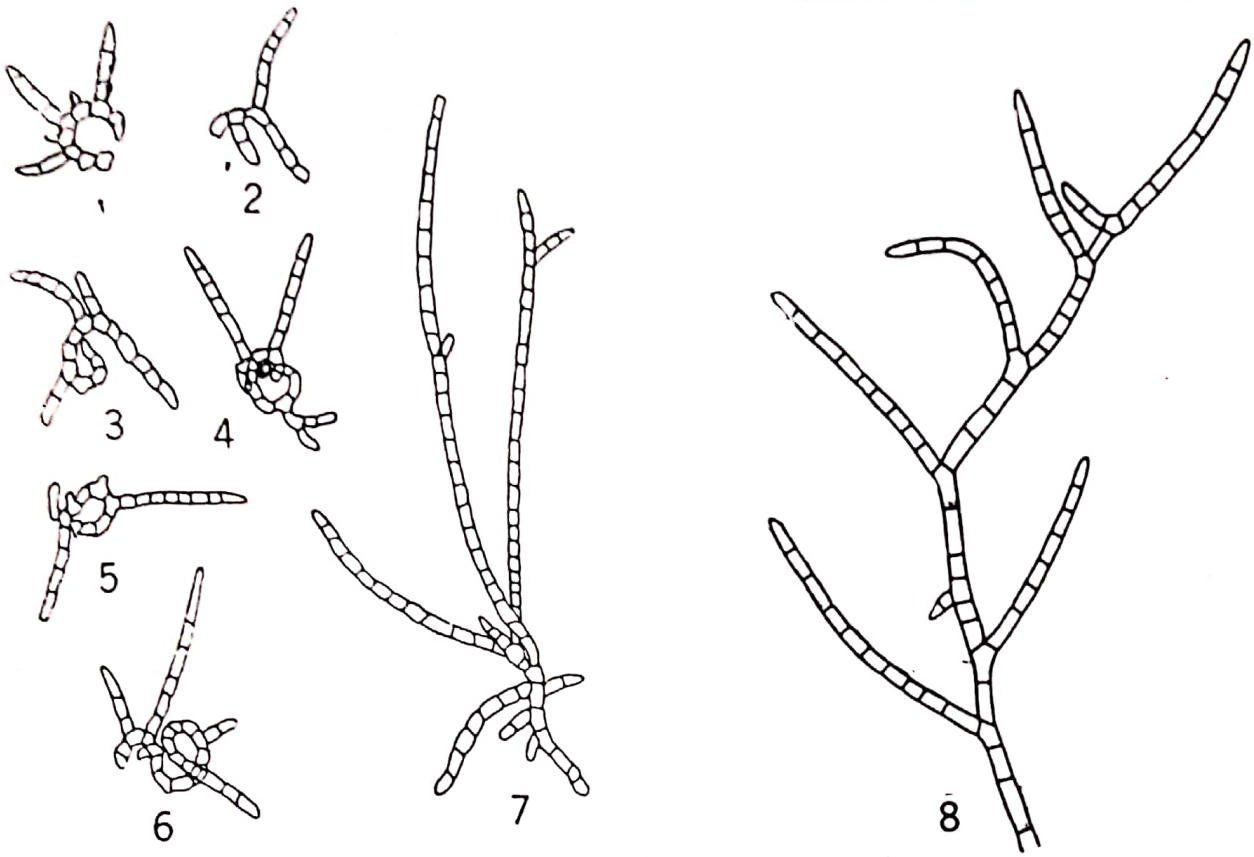
DISCUSSION

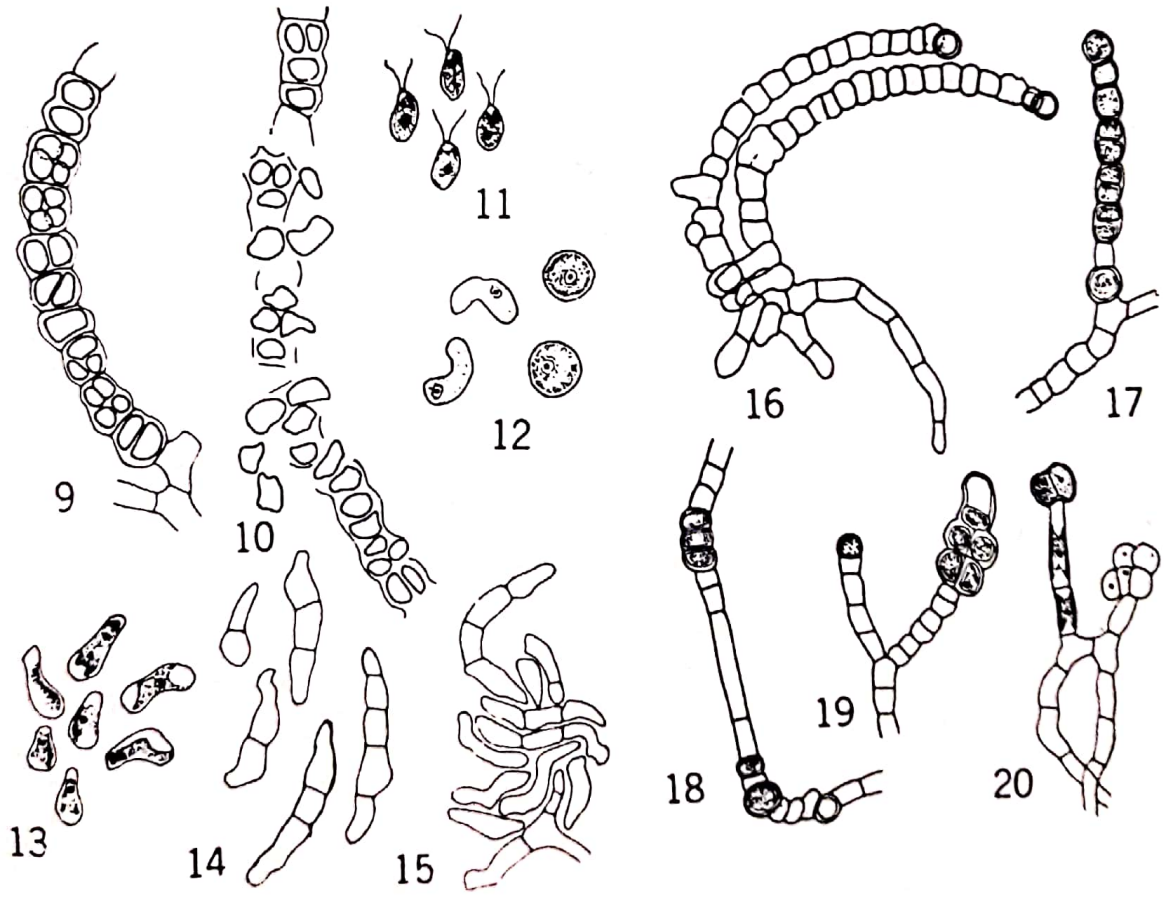
Since there has been a controversy

PLATE I

Figs. 1-20. *Ctenocladus circinnatus* Borzi. Figs. 1-7. Different stages of development of the plants. Fig. 8. Part of the terminal portion of a branch of mature plant to show the nature of branching. Figs. 9-10. Terminal and intercalary cells showing the formation of zoospores. Fig. 10. Shows the liberation of zoospores by the rupture of the parent cells walls. Fig. 11. Biflagellate zoospores. Fig. 12. Resting and germinating zoospores. Figs. 13-15. Stages of germination of zoospores into new plants. Figs. 16-20. Showing akinetes developed terminally or intercalary, singly or in rows or in groups of 2-5. Fig. 20. shows bridge like connections of cells between neighbouring filaments.

(Figs. 1-7 ×206 ; Fig. 8×362 ; Figs. 9-15×548 ; Figs. 16-20×363).





over the two genera, *Ctenocladus* and *Lochmiopsis*, Blinn (1969) studied the autecology of *Ctenocladus* in saline environments. From field and laboratory studies as well as comparison of herbarium sheets, Blinn and Stein (1970) stated that separation of the species merely on the dimensions is incorrect. All the differences in the nature of branching, formation of zoosprangia and dimensions are ecological variations. The salinity of environment plays an important role for such variations. They supported the views of Smith (1950) and Bourrelly (1966) who considered *L. siberica* as a synonym of *Ctenocladus circinnatus* Borzi.

The Gujarat material has also been collected from such type of habitat. *Riella* was also associated with *Ruppia* sp.

PLATE II

Figs. 1-2. *Ctenocladus circinnatus* Borzi. Metaphase and its line drawing showing 12 chromosomes. (Figs. 1-2 ×2090).

and *Najas marina*. The variations such as branching, connection of two neighbouring filaments, akinetes formed in groups of 2-5 observed in the present material might be due to change in salinity and temperature which confirm the observations of Blinn (1970). The habitat, morphological characters and development of the plants from zoospores and akinetes are similar to those observed by Blinn (1970) for *Ctenocladus circinnatus* Borzi.

Mitotic divisions and the nature of the chromosomes agree with the observations of earlier workers, on members of Ulotrichales and Chaetophorales (Sarma, 1958; Abbas and Godward, 1964; Chowdary, 1967). Chromosome counts of n=11 are reported for *Stigeoclonium subspinosum* Kuetz. and *Chaetophora incrassata* (Hudson) Hazen (cf. Abbas and Godward, 1964).

Variable chromosome numbers from 6-13 have been reported in different species of *Stigeoclonium* (Abbas and Godward, 1964; Chowdary, 1967). Chromosome count of 18 is reported for *Trentepohlia aurea* Mart. (Abbas and Godward, 1964). Cytological investigations in the present species suggest that *Ctenocladus* is related to *Stigeoclonium* and *Chaetophora* rather than to *Trentepohlia*.

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*Not seen in original.