Journal of Theoretical and Experimental Biology (ISSN: 0972-9720), **11 (3 and 4)**: 45-50, 2015

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Studies on a Red Alga *Sirodotia huillensis* (Batrachospermaceae) from Orissa State, India

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Received: 15 May, 2015; revised received: 10 June, 2015

Abstract

Sirodotia huillensis (Welwitsch ex W and G. S. West) Skuja is a well known and a common freshwater red alga; it was collected from the submerged stones of streams near the forest farm lands of the R. Udayagiri ranges of Orissa state, India. It was mostly reported from Western Ghats of India and it has been recorded for the first time in Eastern Ghats.

In the present paper, the morphology and reproductive structures of *S. huillensis i.e.,* male and female thallai, branching pattern, spermatia on primary and secondary laterals, asymmetrical carpogonia, distinctly stalked trichogyne and indistinct carposporophyte with globular to obovoid shaped carposporangium are described in detail.

Keywords: *Sirodotia huillensis,* Orissa, Eastern Ghats, gametophyte, trichogyne, carposporangium.

Introduction

The family Batrachospermaceae belongs to the order Batrachospermales and has six well known genera namely *Batrachospermum* Roth (1797), *Kumanoa* Entwisle *et.al.* (2009), *Sirodotia* Kylin (1912), *Nothocladus* Skuja (1934), *Tuomeya* Harvey (1938) and *Sheathia* Salomaki and M.L.Vis in Salomaki *et al.*, (2014).The morphology of the gametophyte of *Batrachospermum, Sirodotia, Tuomeya,* and *Nothocladus* are more are less similar to each other. Necchi and Entwisle (1990) proposed to delimit them from Generic level to section level of genus *Batrachospermum* (*Sheathia* was the member of genus *Batrachospermum* and recently rose to generic level). But, later phylogenetic studies revealed a distinctive genus level of the above with full support in bootstrap analysis (Vis*etal*., 1998) and *Sirodotia* has been raised to generic level.

The genus *Sirodotia* has been recognized by the two important reproductive characters such as asymmetrical carpogonium in the gametophyte and indeterminate/ indistinct gonimoblast filament in the carposporophyte (Starmach, 1977; Necchi *et al.*, 1993; Kumanoa 2002). Further recognition of species inside the genus is done by various distinct characters like morphology of the gametophyte, position of spermatangia, position of the carpogonial branch, gonimoblast filament arising from the side of from carpogonium, and the size of the carpogonium (Starmach, 1977; Necchi *et al.*, 1993, 2007). Although there are 21 species in the genus *Sirodotia* (Guiry and Guiry, 2015), Kumanoa (2002) in his review of freshwater red algae of the world recognized only eight species and fourteen species were taxonomically accepted by Guiry and

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Guiry (2015). *S.huillensis* is cosmopolitan in distribution whereas some species were known from few locations and few are endemic (Kumanoa, 2002).

Material and Methods

Collection

Fresh materials were collected from a running stream of R. Udayagiri range, nearby the villages Khajuripada and R.Udhayagiri (N20.135414, E 84.377808), Orissa State in December 2012.

Preservation

All the materials were preserved in 4% formalin and enriched with 10% glycerin in plastic bottles with proper labeling. Some material was freshly placed on the paper for dry preservation (herbarium).

Staining and Mounting

Staining was done with methylene blue or alcian blue and mounted in 50% glycerin. Cottonblue-lactophenol was also used as a staining medium for few observations and aceto-carmine is used for Pseudochantransia stages. Hydrofluoric acid treatment was given to get rid of soil particles in some cases.

Observation and Documentation

The materials were observed under E. Leitz Wetzlar Microscope (Germany) and documented. Photomicrographs were taken using UCMOS Photography unit and CCD & CMOS Digital Camera Solution Software Ver. 3.5 was used to analyze the photomicrographs and Leica EC3 System. Camera Lucida sketches also was made.

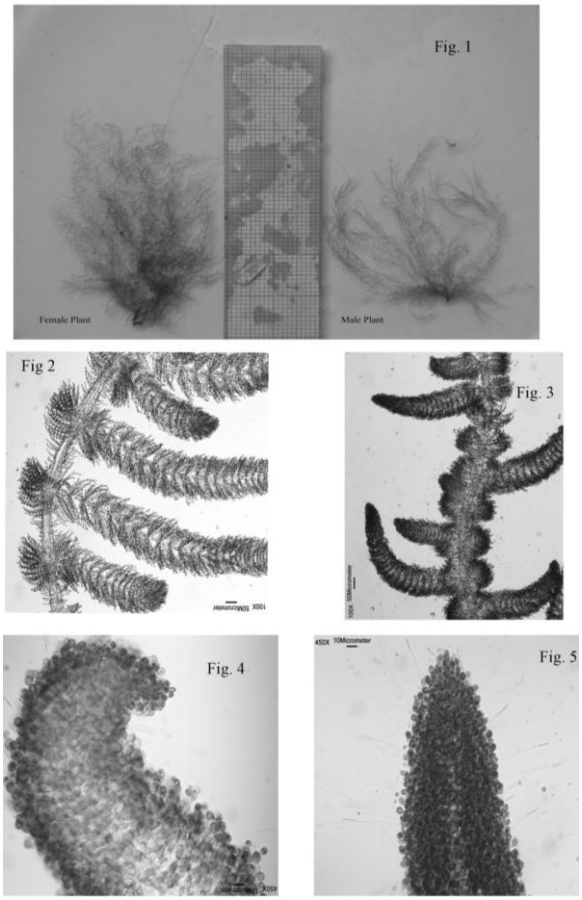

Plate 1: Fig. 1: Male and female thalli; Fig. 2: Branching and tip portions of female thalli; Fig. 3: Branching and tip portions of male thallus; Fig. 4: Curved tip of female thallus; Fig. 5: thallus showing Straight tip and Presence of hairs.

Species Description

Plant height ranges from 6-10 cm, thallus moderately mucilaginous, abundantly branched, branches arise from the internodes; a few grows like main axis and others remaining short, giving a false appearance of sparse branching. Colour of the gametophyte varies from light green to olive green. Primary and secondary fascicles (whorls) are produced all along the plant body which gives beaded appearance to the thallus. The inter-nodal region has secondary fascicles which are globular when young and obconical (cone) at maturity. The whorls are 280.50 – 540.10 µm in diameter and 210.85 to 764.95 µm long. Apical cells are dome shaped, 5.49 - 6.70µm long and 3.82 – 4.25µm broad. Internodes are long, slender, measuring 317 – 864.30 µm in length and 35 - 66 µm in breadth. Basal cells are 6.4 – 8.35 µm diameter, globular to sub-globular in shape. 2 - 3 primary laterals arise from each basal cell which is6 – 12 cells long. Cells broader towards tip, obovoidal to elliptic in shape; 11.50- 14.10 µm long and 3.80 – 7.25 µm broad. Cortical cells 1 - 2 per basal cell, measuring 3.15 – 6.55 µm broad, and 10.20 - 29.20 µm long. Secondary laterals abundant, initiated from the cortical filaments, 3 – 9 (~11) celled long; cells obovoidal, 14.35 - 19.15 µm long, 3.50 – 6.10 µm broad, unbranched or rarely branched.

Plate II

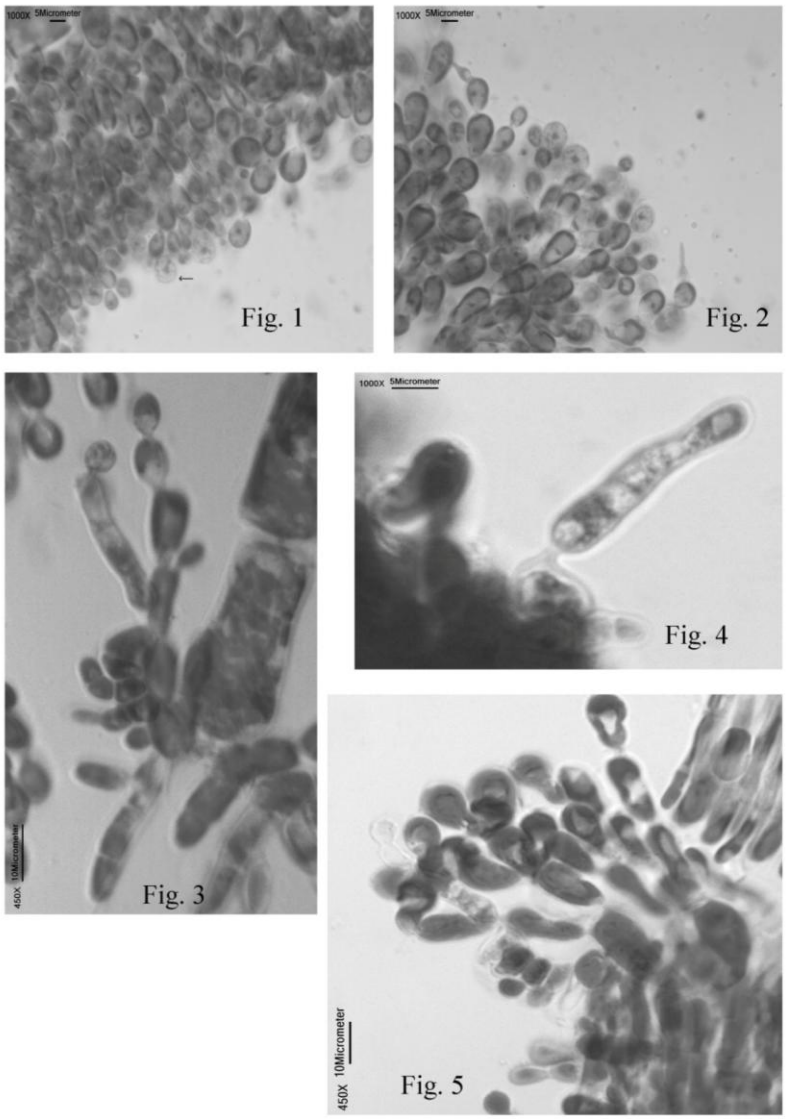

Plate 2: Fig. 1 and 2: Shows the presence of Spermatangium; Fig. 3: Shows the carpogonial branch; Fig. 4: Shows the Carpogonium and distinctly stalked Trichogyne; Fig. 5: shows the carpogonia and carpogonial branch.

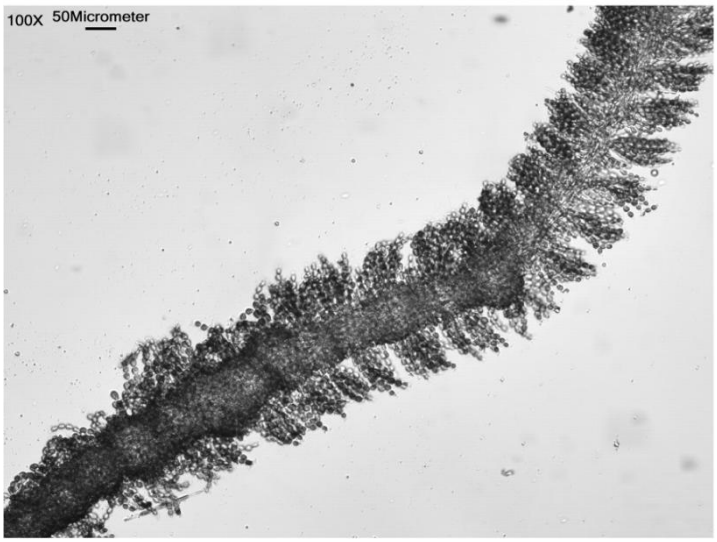

Plate 3: Portion of the Thallus enlarged to show Indistinct Carposporophyte.

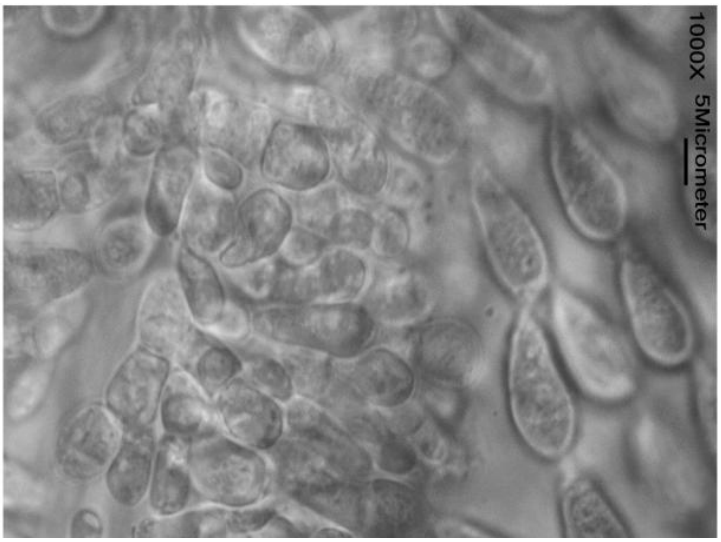

Plate 4: Portion of Carposporophyte enlarged to show Carposporangium and Gonimoblast filament.

Male plants have protruding apical cells in dominance (>70%) with straight tips whereas female plants are with curved tips and non-protruding apical cells in dominance Male plants also possesses prominent long, thin, slender hairs, 10.30 - 93.65 µm long with bulbous base. In female plants hairs are absent.

Plant is diecious and monoecious. Spermatangia are produced in separate male plants on both primary and secondary laterals, apical or sub apical in position which are either single or in clusters, pairs are also common. The diameter of spermatia ranges from 5.65 to 7.80µm. Carpogonial branches are produced from the basal cells at the nodal region of the female plants. First carpogonial branch arises at 15-30th axial cells, 1-2 per basal cell, 3-5 cell long, slightly curved with distinctly stalked cylindrical trichogyne on the dorsal side of asymmetrical carpogonium. Carpogonium slightly protruded or broader on ventral side and 7.50 to 12.85 µm in diameter, trichogyne cylindrical elongated with wavy margin, 23.45 – 31.25 µm long and 4.50 – 5.55µm in width. The initiation of Gonimoblast filament starts from the ventral side of Carpogonium. Gonimoblast filaments creeping along the cortical filaments and producing 2 - 4 celled branches, which forms carposporangium. Gonimoblast filaments are often found growing towards both upward and downward directions. Carposporangium globular to obovoidal in shape 7.05 – 8.05 µm diameter and 7.80 – 12.70 µm long. Tetrasporophytes are microscopic,

filamentous and heterotrichous. Cells of erect filaments are cylinder shaped, 8.30 – 14.40 µm long and 5.10 – 7.45 µm broad.

Discussion

The present study confirms, genus *Sirodotia* by the presence of asymmetrical carpogonium and indistinct Carposporophyte (Starmach, 1977; Necchi *et al.*, 1993; Kumanoa 2002). Though Kumano (2002) in his monograph considered *S. cirrhosa* as a synonym of *S. huillensis*, species, characters such as monoecious and dioecious nature, thallus 6-10 cm long, light green to olive green in colour, cone shaped whorls and the branching pattern were similar to the description given by Balakrishnan and Chaugule (1980). Reproductive characters like spherical spermatia, on both primary and secondary laterals, and also diameter of spermatia are more or less similar. Shape of the carpogonium and the protuberance on carpogonium are additional supports for the confirmation. The Gonimoblast filament which arises from the same side of protuberance is yet another important identifying feature of the species (Starmach, 1977; Necchi *et al.*, 1993, 2007). The presence of globular to obovoidal shaped carposporophyte and its diameter range also adds value to the confirmation of the current specimen is *S. huillensis.* In 2006 diecious plants of *S. huillensis* were observed by Carmona *et. al.* While considering the previous observations hence it is proved that the *S. huillensis* has both diecious & monoecious plant body.

Conclusion

In the present study the morphology and reproductive structures of *Sirodotia huillensis* were described in detail. Characters like male and female thallai, branching pattern, spermatia on both primary and secondary laterals, carpogonia asymmetrical, trichogyne distinctly stalked and indistinct carposporophyte with globular Carposporangium are similar to the description reported earlier from India and the thallus is both diecious and monoecious. Though there were several records of *S. huillensis* in Western Ghats, it has been reported for the first time from Orissa State as well as in Eastern Ghats of India.

Acknowledgement

The Authors take this opportunity and thank the Funding agency, University Grants Commission (UGC) for providing the necessary funds to carry out the Project successfully.

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