

**SIROCLADIUM KUMAOENSE RANDHAWA (ZYGNEACEAE)— A RARE
TERRESTRIAL ALGA FROM DARJEELING HIMALAYAS**

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Darjeeling district is located in the provinces of eastern Himalayas (87°59' to 88° 53' E longitude and 26°31' to 27°15' N latitude) at an average altitude of 2500 m. In this work a member of Zygnemaceae have been morpho-taxonomically described which is unique in two respect from the other members of Conjugales being terrestrial in nature and do not develop conjugation tube during the process of conjugation. The other important aspect of this specimen is the adaptation in high altitude as well as persistency of zygospore in low winter temperature.

MATERIALS AND METHODS

The algal samples in form of light greenish coloured velvety felt on humid garden soil in shady open aerated soil were collected from Lloyd Botanical Garden (altitude 2360 m) in successive two years (2006 and 2007). Detailed ecological notes like pH, temperature and association were also recorded at collection spot. Algal filaments were collected from soil with help of forceps and collected in 30 ml plastic specimen tubes (Tarson). The specimens were preserved in FAA (Formalin-acetic acid-ethyle alcohol) and 10% glycerin was used for mounting. For details morphological study a compound microscope (Meopta, model 222070) fitted with 6x, 20x, 40x, 50x, 100x objective lance and 10x eye piece was used. Photography was taken using a standardized digital camera (Olympus, model FE 210). Line drawing was made both from live and preserved specimens using a prism type Camera Lucida. Collected specimens were preserved in Botany Department, Darjeeling Govt. College, Darjeeling. The specimens were taxonomically characterized and identified with the help of pertinent literature (Lagerheim, 1883, Fritsch, 1935, Randhawa, 1941b, Smith, 1950, Transeau, 1951, Singh, 1958c, Randhawa, M.S. 1958a, Randhawa, M.S. 1958b Randhawa, 1959, Chowdary, 1968, Rieth, 1975, Santra and Adhya, 1977, Kadlubowska, 1984, Bold and Wynne, 1985, Dias and Bicudo, 2006, Pereira and Branco, 2007).

OBSERVATIONS

On the basis of habitat, detailed morphological and taxonomical study the specimen was identified as *Sirocladium kumaoense* Randhawa.

The morpho-taxonmic description of the specimen is as follows:

Thallus light greenish in colour producing a loose mat on the surface of garden soil. Under microscope it shows filamentous structure consisting of some cylindrical cells jointed end to end growing with two Blue-green algal member *Nostoc muscorum* and *Microcoleus lacustris*. *Nostoc* filaments were intermingled with *Sirocladium* filament externally in form of rosaceous colony (**Fig. 1.A**) and also internally within the cell (**Fig. 1.B**) whereas the *Microcoleus* filament grown externally in form of a bundle of ensheathed trichome (**Fig. 1.C**). vegetative cells are 120-200 µm long and 50-60 µm in breadth with two parietal plate like chloroplast, chloroplast length 15-17 µm and 3-5 µm in breadth associated with 6-10 pyrenoids irregularly scattered (**Fig. 1. D, E, F, G**). Filament monoecious, conjugation takes place between male and female cells of the same filament, gametangia geniculate type, the receptive one is inflated (**Fig. 1.H, I**). Zygospore ellipsoid in

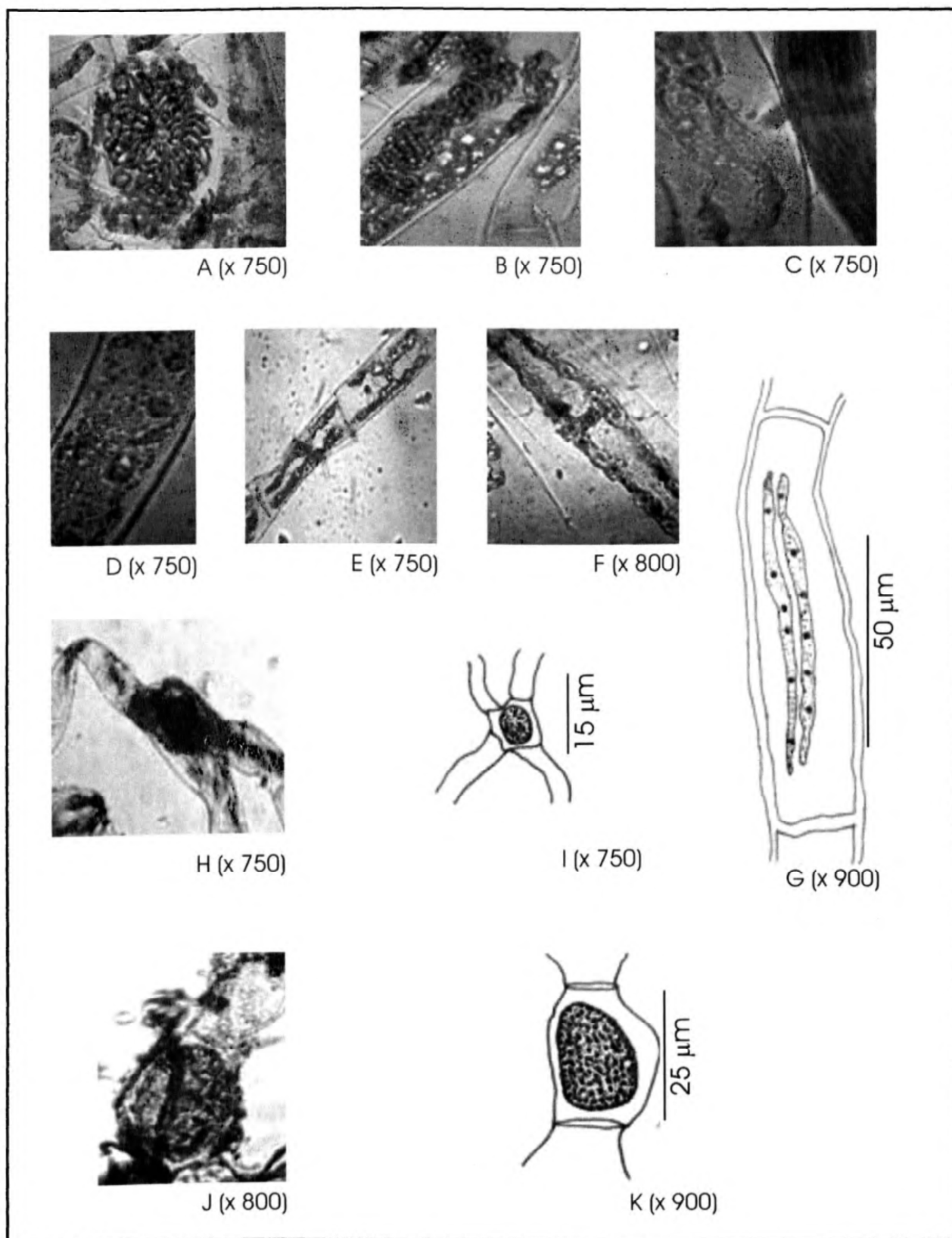


Fig. 1. : **A.** *Nostoc* colony intermingled with the *Sirocladium* filament; **B.** *Nostoc* colony within *Sirocladium* filament; **C.** *Microcoleus* filament intermingled with the *Sirocladium* filament; **D.** Yong *Sirocladium* cell with immature chloroplast; **E.** Mature filament with two plate like chloroplast; **F.** A single cell with two plate like chloroplast; **G.** Camera lucida drawing of single cell with two plate like chloroplast; **H.** A single geniculate gametangium; **I.** Camera lucida drawing of a geniculate gametangium; **J.** A developed Zygospor; **K.** Camera lucida drawing of a developed zygospor.

shape and $50 \times 100 \mu\text{m}$ in dimension (Fig. 1. J, K). Mature zygospore wall smooth and yellowish in colour. The specimen was collected from last week of May to last week of December in successive two years (2006, 2007), pH and temperature of the garden soil recorded was ranging from 6.5 to 7.0 and 7 to 21°C respectively. Its abundant growth noticed during the month of June to October as compared to other months of the year. Conjugative stage first noticed in the first week of September and became plenty in number with ripe zygospores till last week. The growth rate declined in the month of November and totally disappeared in the first week of December with onset of high intensity of winter. The spores remain dormant in soil and again germinate in next May in the same spot producing the filamentous structures.

DISCUSSION

The members of the Zygnemaceae have a wide-spread distribution over the surface of the globe (Meneghini, 1838). Intensive work on this family has been done in Europe, USA, China and India (Randhawa, 1959). A total of 13 recognized genera and 536 species have been included in this family (Transeau, 1951). Of which *Sirocladium* having restricted distribution and reported only from India, Cuba and Brazil (Pereira and Branco, 2007). The genus was erected by Randhawa in 1941. Three species of this genus were reported by him, of which *S. kumaoense* reported from Gananath, Nainital, Kumaon hills, Almora of U.P and Calcutta, and *S. vandalurens* and *S. maharashtrense* from south India. Another Indian species (*S. himalayensis*) was reported and constructed by Santra and Adhya (1977) from eastern Himalayas. In addition to these, another species (*S. cubense*) has been reported from humid soils of Cuba (Rieth, 1975). The most recently described species (*S. robustum*) has been constructed by Pereira and Branco in 2007 from northwest region of the State of São Paulo, in Brazil. Though *S. kumaoense* was reported and designated as type species of the genus *Sirocladium* by Randhawa from western Himalayas and Calcutta (West Bengal) but still there is no report of this species from Darjeeling Himalayas. This may be the first such report. The other interesting and significant finding during present study is the blue-green algal association with the *Sirocladium* thallus. The morpho-taxonomic study carried out in the present work is based on observations under compound microscope and is at preliminary level. The parthenospore and aplanospore has not been identified and characterized in this work. The Cyanobacterial association needs to be studied at physiological and biochemical level.

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