



## Identification of genus *Closterium* species (Nitzsch ex Ralfs) from the Tirumala hills, Chittoor district of Andhra Pradesh, India

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### Abstract

Fresh water taxonomical studies on Tirumala hills reported 16 taxa of *Closterium* species, which are first reported from the study area and as well as Chittoor district. Among them 8 species are first reported from the Andhra Pradesh. They are *Closterium acerosum* var. *angolense*, *Closterium delpontei*, *Closterium incurvum*, *Closterium jenneri* var. *jenneri*, *Closterium littorale* var. *littorale*, *Closterium ralfsii* var. *hybridum*, *Closterium subulatum* and *Closterium venus*.

**Keywords:** *Closterium*, fresh water taxonomical studies, Tirumala hills, closteriaceae, India

### Introduction

The Tirumala hills is the holy place of lord Venkateswara, which is one of the richest temple in India and distributed in 10.33 sq miles geographical area of Chittoor district, Andhra Pradesh. It is located 3, 200 feet above the sea level and exists in latitude and longitude of 13.6500 N and 79.42 E. Seshachalam hill ranges well established with permanent and temporary water bodies. The Tirumala hills have the rare, endangered, vulnerable and endemic plants.

*Closterium* cells are almost solitary, elongate or extended conical or narrow ends, presence of gridle bands and smooth walls, without median constriction. Outer wall ornamented with warts, spine or ridges and walls may be colourless or stained. New semi cells formed by the cell division.

### Materials and methods

The altitudinal variation, lotic and lentic conditions, algal diversity were taken into consideration for selection of sites for the study of algal diversity and the 5 sites (Papavinasam, Akasha Ganga water falls, Gogarbam Theertham, Vakulamatha cheruvu and Talakona) have been selected. Several field trips were made to collection sites, in different seasons. Every collection was given a field number and colour of the alga material are noted. Algae were temporally collected in Zip lock covers and kept in ice box to prevent deterioration. Temporary slides were prepared with water mounts and with Lugol's solution or Aniline blue, slides were sealed with DPX.

Samples were observed under CHi 20 Olympus bright field binocular micro scope. Organisms were observed under 4X, 10X, 40X and 100X, Size and colour was noted down. Rough sketches were made and characters were described in a separate note book. Photographs were taken with Sony and Olympus camera. Algae were identified based on key characters by using Algal floras, monographs and available research articles from journals (Alan J. Brook and David B. Brook (2010) [1], Archer (1862) [2], Brébisson (1856) [3], Gay (1884) [4, 5], Gupta (2012) [7], John D. Wehr *et al* (2015) [8], Johnson (1895) [9], Lütkemüller (1905) [10],

Nägeli (1849) [11], Ralfs (1848) [12], Rabenhorst (1863) [13] and Rabenhorst (1868) [14]. And compared information and photographs with Algae base (Guiry and Guiry (2019) [6].

### Results

Investigation yielded about 16 species belong to the genus *Closterium*, family Closteriaceae.

### Systematic Enumeration

***Closterium acerosum* var. *angolense* West & G.S. West 1897, Plate: I, Fig: 1**

Cells 500 µm in long, 25 µm in wide, straight, parallel margins attenuated and cell ends tend to be rounded, chloroplast stelloid with 3-4 longitudinal ridge.

Collection number: Gogarbam Theertham, 003, 0006, 019.

Distribution: First report from Andhra Pradesh.

***Closterium cornu* Ehrenberg ex Ralfs 1848 [12], Plate: I, Fig: 2**

Cells narrow, slightly curved, arc 40°, wall colour less, smooth, chloroplast stelloid, 3 lamellated ridges, 2 evenly spaced axile pyrenoids.

Collection number: Papavinasam dam, 022.

Distribution: Reported in Andhra Pradesh.

***Closterium delpontei* (Klebs) Wolle 1885, Plate: I, Fig: 3**

Cells 300 µm long, 35 µm wide, narrow, chloroplast stelloid with 16 axile pyrenoids, small terminal vacuoles with one or two rhomboidal crystals.

Collection number: Vakulamatha cheruvu, 014.

Distribution: First report from Andhra Pradesh.

***Closterium diana* var. *arcuatum* Ehrenberg ex Ralfs 1848 [12], Plate: I, Fig: 4**

Cells 220 µm long, 20 µm in wide, strongly curved, arc between 140°-152°, ventral margin concave, apices with 4 µm wide and

14 µm long, stelloid chloroplast, each chloroplast contains 6 pyrenoids, apices with elliptical moving crystal.

Collection number: Papavinasam dam, 004, 016.

Distribution: Reported in Andhra Pradesh.

***Closterium incurvum* Brébisson 1856<sup>[3]</sup>, Plate: I, Fig: 5**

Cells, 105 µm in length, 15 µm in wide, bow shaped, arc at 180°, stelloid chloroplast with 3 lamellae, 2 axile pyrenoids and contains the moving crystals.

Collection number: Papavinasam dam, 0001, 0006, 019.

Distribution: First report from Andhra Pradesh.

***Closterium jenneri* var. *jenneri* Ralfs 1848<sup>[12]</sup>, Plate: I, Fig: 6**

Cells 180 µm length, 22 µm wide, strongly curved, chloroplast stelloid, each side with 5 axile pyrenoids, terminal vacuoles have the single compound crystal.

Collection number: Akasha Ganga waterfalls, 025.

Distribution: First report from Andhra Pradesh.

***Closterium littorale* var. *littorale* West & G.S. West 1896, Plate: I, Fig: 7**

Cells 270 µm in length, 25 µm wide, almost straight, tumid, attenuated, apices rounded, slightly obtuse, the wall colour less, stelloid chloroplast with spherical shape pyrenoid in the axis, single fused crystal mass.

Collection number: Gogarbam Theertham, 0024, 020, 09.

Distribution: First report from Andhra Pradesh.

***Closterium moniliferum* Ehrenberg ex Ralfs 1848<sup>[12]</sup>, Plate: I, Fig: 8**

Cells 150 µm long, 28 µm wide, moderately curved, arc at 82°, chloroplast stelloid with 3 longitudinal ridges, chloroplast contains 2-10 pyrenoids in axile position.

Collection number: Gogarbam Theertham, 09.

Distribution: Reported in Andhra Pradesh.

***Closterium navicula* (Brébisson) Lütkemüller 1905<sup>[10]</sup>, Plate: II, Fig: 9**

Cells 70 µm long, 16 µm width, straight, rounded apices, fusiform.

Collection number: Vakulamatha cheruvu, 0009.

Distribution: Reported in Andhra Pradesh.

***Closterium parvulum* Nägeli 1849<sup>[11]</sup>, Plate: II, Fig: 10**

Strongly curved cells, arc between 102° – 158°, almost straight in mid region, cells attenuated, apices acutely rounded, chloroplast stelloid, 3 visible longitudinal ridges, each chloroplast with 6 axile pyrenoids, 8 moving crystals.

Collection number: Gogarbam Theertham, 007, 011, 0004.

Distribution: Reported in Andhra Pradesh.

***Closterium pritchardianum* W. Archer 1862<sup>[2]</sup>, Plate: II, Fig: 11**

Cells 600 µm in length, 30 µm in width, narrow, slightly curved, outer margin 24° arc, sub truncated apices, chloroplast stelloid with 16 axile pyrenoids.

Collection number: Gogarbam Theertham, 008, 007.

Distribution: Reported in Andhra Pradesh.

***Closterium ralfsii* var. *hybridum* Rabenhorst 1863<sup>[13]</sup>, Plate: II, Fig: 12**

Cells 350 µm long, 27 µm in wide, narrower than normal variety, tumid, two stelloid chloroplast 3 longitudinal ridges, each chloroplast with 7 pyrenoids.

Collection number: Talakona, common in all collection.

Distribution: First report from Andhra Pradesh.

***Closterium subulatum* (Kützing) Brébisson 1856<sup>[3]</sup>, Plate: II, Fig: 13**

Cells 155 µm in length, 21 µm width, narrow, slightly curved, mid region almost straight, apices subtruncate, chloroplast stelloid, 4 axile pyrenoids, numerous moving crystal.

Collection number: Akasha Ganga waterfalls, 024.

Distribution: First report from Andhra Pradesh.

***Closterium tumidulum* F. Gay 1884<sup>[4,5]</sup>, Plate: II, Fig: 14**

Cells strongly curved, slightly tumid, chloroplast stelloid, 3 longitudinal ridges with 4 axile pyrenoids.

Collection number: Papavinasam dam, 0008, 012.

Distribution: Reported in Andhra Pradesh.

***Closterium tumidum* L.N. Johnson 1895<sup>[9]</sup>, Plate: II, Fig: 15**

Cells 98 µm in length, 15 µm in width, mid region tumid, apices truncate, stelloid chloroplast, do not expand to the cell apices, 6 pyrenoids in each section, apices in the several moving crystals.

Collection number: Talakona, 009, 012.

Distribution: Reported in Andhra Pradesh.

***Closterium venus* Kützing ex Ralfs 1848, Plate: II, Fig: 16**

Cells strongly curved, 170° arch, chloroplast stelloid with 2 axile pyrenoids in each side, terminal vacuoles contain the moving crystals.

Collection number: Papavinasam dam, frequent in all collection.

Distribution: First report from Andhra Pradesh.

### Discussion

In Andhra Pradesh desmids were studied by Vidyavatathi and Niizam (1970, 1974 and 1975), no attempt taken in the Chittoor district. This was first report on the *Closterium* of Chittoor district. And comprehensive data of freshwater algae of Andhra Pradesh is not available yet. Hence the present attempt gains importance and generate interest on potential utilization, sustainable management of algal wealth. Algae have the great importance in ecological and economical contest. Hence the availability of systematic details, diversity and distribution is essential for future research work. *Closterium* species abundant Gogarbam Theertham area, species diversity rich in the Papavinasam dam. *Closterium venus* is frequent in all collections of Papavinasam dam area.

### Conclusion

In Tirumala hills collection not done for *Closterium*, so these studies first are contribution to the fresh water algae of Andhra Pradesh. 16 species of *Closterium* reported, which are first reported from the study area and Chittoor district. Among them 8 species were first reported from the Andhra Pradesh. They are *Closterium acerosum* var. *angolense*, *Closterium delpontei*, *Closterium incurvum*, *Closterium jenneri* var. *jenneri*, *Closterium littorale* var. *littorale*, *Closterium ralfsii* var. *hybridum*, *Closterium subulatum* and *Closterium venus*.

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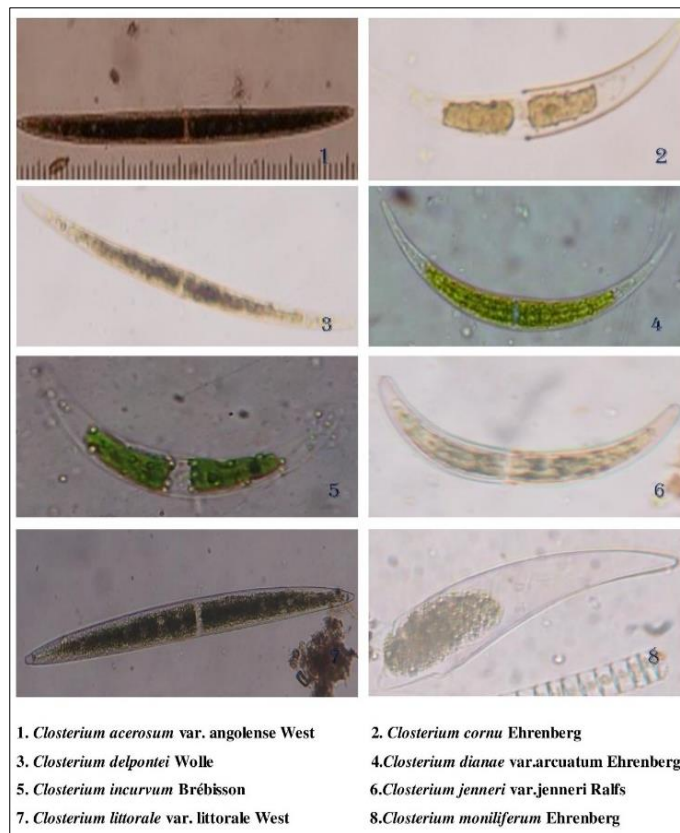


Plate 1

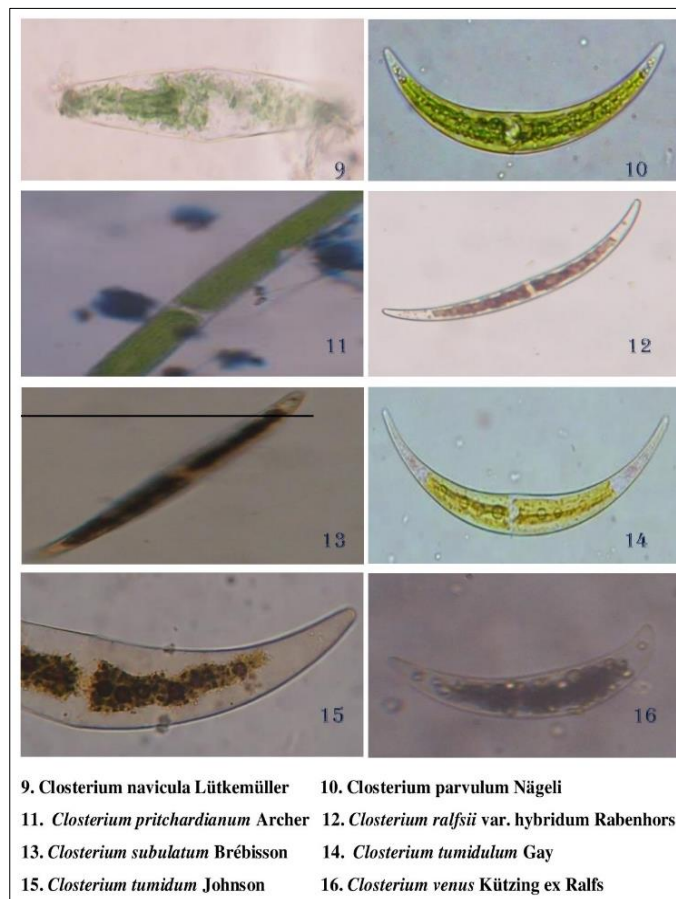


Plate 2

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