

## RESEARCH PAPER

## Desmids from rivers of Chandrapur district, Maharashtra

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## ABSTRACT

During the study of the micro and macro flora of major rivers of Chandrapur district in Maharashtra, 45 taxa of desmids were encountered. Among these, 26 are *Cosmarium*, 8 *Staurastrum*, 6 *Closterium*, 2 *Desmidium*, 2 *Euastrum* and one *Actinotaenium*. This paper deals with the systematic study and distribution of these desmid taxa in Chandrapur district. Among these, 3 taxa are new reports for India and 4 taxa are new reports for Maharashtra state.

KEYWORDS: Chandrapur, Rivers, Desmids, systematic study, new reports.

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## Introduction

Desmids are the microscopic, unicellular, fresh water green algae, which are differentiated from other Chlorophytes by having semicells and connecting isthmus. Desmid flora of different parts of the country and the state have been investigated by different workers (Suxena and Venkateswarlu, 1966); (Dwivedi *et al.*, 2009); (Shukla *et al.*, 2008); (Yasmin *et al.*, 2011); (Hegde, 1986); (Sindhu and Panikar, 1995); (Patil and Kumawat, 2014 & 2015); (Agarkar *et al.*, 1979); (Agarakar and Agarkar 1977); (Das and Keshri, 2012 a & b, 2013 a & b); (Dhande and Jawale, 2009); (Mallick and Kesari, 2011); (Bharati and Hegde, 1982). However the rivers of the Chandrapur district are still unexplored. Present paper is a part of taxonomic study of micro and macro flora of major rivers of Chandrapur district, Maharashtra. During 2013-2015, the major rivers Wardha, Painganga and Weinganga were explored for their biological wealth.

Chandrapur is the eastern district of the Maharashtra state, located between 18° 41' to 20° 50' North Latitudes and 78° 48' to 80° 55' East Longitudes (fig. 1). Physiographically it is situated in the Wainganga and Wardha river basin. The area is drained by major tributaries Wardha, Wainganga and Painganga rivers of the Godavari river. In present study total 21 sites (Table 1) were selected to monitor micro and macro flora of the rivers. These sites are randomly placed and approximately equidistant from each other.

## Material and method

Samples were collected from all 21 sites during May, August, November and February months of 2013-15 period. From every site, approximately 50 liters of running water is filtered through phytoplankton net of 20 µ mesh size made of bolting silk. The filtrate was preserved in 4% formaldehyde solution. Microphotography done with the help of Coslab camera inbuilt



Figure 1. Location of Chandrapur district.

Table 1. Sample collection sites.

S.No	Site	Area	Coordinates
1	S1	Pardi	19° 44' 28.176" N; 78° 54' 46.584" E
2	S2	Bori	19° 48' 23.4756" N; 78° 59' 58.8588" E
3	S3	Gadegaon Wirur	19° 51' 48.456" N; 79° 7' 25.464" E
4	S4	Dhanora	19° 54' 13.104" N; 79° 11' 2.328" E
5	S5	Kadoli	19° 52' 30.756" N; 79° 17' 16.512" E
6	S6	Sasti	19° 50' 1.464" N; 79° 20' 6.864" E
7	S7	Rajura	19° 48' 48.528" N; 79° 22' 29.604" E
8	S8	Koipara	19° 45' 59.544" N; 79° 29' 24.9" E
9	S9	Arvi	19° 38' 1.0428" N; 79° 29' 21.5088" E
10	S10	Polsa	19° 30' 28.8756" N; 79° 35' 18.7224" E
11	S11	Tatepalli	19° 34' 54.948" N; 79° 42' 13.2336" E
12	S12	Gugus	19° 57' 19.7136" N; 79° 5' 56.6448" E
13	S13	Patala	20° 7' 39.324" N; 78° 59' 48.0192" E
14	S14	Soit	20° 16' 45.0084" N; 78° 49' 5.4912" E
15	S15	Gondpipri - Ashti	19° 40' 38.4456" N; 79° 47' 7.6596" E
16	S16	Gangapur	19° 50' 28.0032" N; 79° 45' 14.1048" E
17	S17	Saoli - Chamorshi	20° 0' 28.818" N; 79° 47' 10.4424" E
18	S18	Saoli - Gadhiroli	20° 8' 5.5572" N; 79° 55' 24.9816" E
19	S19	Kudesawali	20° 19' 24.6468" N; 79° 56' 58.1388" E
20	S20	Brahmapuri - Armori	20° 28' 58.9512" N; 79° 56' 47.202" E
21	S21	Brahmapuri - Wadsa	20° 37' 9.7212" N; 79° 56' 24.6444" E

trinocular microscope. Plants were identified with the help of standard books, floras, monographs and research papers (Delponte, 1876; West & West 1904, 1905, 1908, 1912; West et.

al., 1923; Smith, 1924; Suxena and Venkateswarlu, 1966; Coesel, 1984).

### Taxonomic enumeration

In the present study, total 45 desmid taxa including *Actinotaenium* (1), *Closterium* (6), *Cosmarium* (26), *Desmidium* (2), *Euastrum* (2), *Staurastrum* (8) were isolated from the rivers. Their taxonomic details, characters and distribution details are as follows.

Family DESMIDIACEAE Ralfs.

*Actinotaenium* (Nageli) Teiling 1954.

1. *Actinotaenium diplosporum* (P.Lundell) Teiling 1954. [fig. 23]

Basionym: *Cylindrocystis diplospora* P.Lundell 1871.

Synonym: *Cylindrocystis diplospora* var. *major* West 1892;

*Cosmarium diplosporum* (P.Lundell) Lutkemüller 1913.

[West & West 1904, p. 61, pl. IV, f. 42, 43]

Cells large, about twice as long as broad, cell wall punctate.

Cell sub cylindrical, very slightly constricted in the middle, slightly dilated towards apex. Lateral walls of the semi cells slightly convex, apex rounded.

Size: Cell: 45µ-55µ × 95µ-100µ.

Occurrence: S15

This is probably first report of the taxon from Maharashtra.

*Closterium* Nitzsch 1848.

2. *Closterium leibleinii* Kützing ex Ralfs 1848. [fig. 14]

[West & West 1904, p. 141, pl. XVI, f. 9-14]

Cells medium sized, about 7-8 times as long as broad, cell wall smooth. Cells strongly curved, inner margin concave with slight inflation in the middle. From center gradually attenuated to obtuse apices. Chloroplast with 5-6 pyrenoids arranged in a row.

Size: Cell: 21µ-24µ × 140µ-160µ.

Occurrence: S20, S21

3. *Closterium lunula* f. *minor* West & G.S.West 1904. [fig. 12]

[West & West 1904, p. 151]

Cells large, about 5-6 times as long as broad, cell wall smooth. Cells almost straight with outer margin slightly curved, inner margin straight with slight inflation in the middle. From center gradually attenuated to rounded apices. Chloroplast with many scattered pyrenoids.

Size: Cell: 58µ-65µ × 280µ-320µ.

Occurrence: S15, S16

4. *Closterium moniliferum* (Bory) Ehrenberg 1838. [fig. 4]

[West & West 1904, p. 142, pl. XVI, f. 15-16]

Cells large, about 8 times as long as broad, cell wall smooth. Cells moderately curved, inner margin concave with distinct inflation in the middle. From center gradually attenuated to obtuse apices. Chloroplast with 6-7 pyrenoids arranged in a row.

Size: Cell: 40µ-44µ × 320µ-360µ.

Occurrence: S7, S17, S18

5. *Closterium parvulum* Nageli 1849. [fig. 5, 18]

[West & West 1904, p. 133, pl. XV, f. 9-12]

Cells small sized, about 9-10 times as long as broad, cell wall smooth. Cells strongly curved, inner margin concave without inflation in the middle. From center gradually attenuated to near acute apices. Chloroplast with 4 pyrenoids arranged in a row.

Size: Cell: 14µ-17µ × 130µ-180µ.

Occurrence: S17, S21

6. *Closterium parvulum* var. *angustum* West & G.S.West 1900. [fig. 3]

[West & West 1904, p. 134, pl. XV, f. 13-14]

Cells small and thinner than type.

Size: Cell: 7µ-8µ × 120µ-130µ.

Occurrence: S19

7. *Closterium species* [fig. 2]

Cells larger, about 6-7 times as long as broad, cell wall smooth. Cells moderately curved, inner margin concave with slight inflation in the middle. From center gradually attenuated to obtusely rounded apices. Chloroplast with many pyrenoids arranged in a row.

Size: Cell: 70µ-75µ × 400µ-500µ.

Note: Similar to *Closterium ehrenbergii*, but in present taxa pyrenoids are arranged in a single row instead of random distribution.

Occurrence: S6, S7

*Cosmarium* Corda ex Ralfs 1848.

8. *Cosmarium abbreviatum* Raciborski 1885. [fig. 20]

[West & West 1908, p. 84, pl. LXXII, f. 9-11]

Cells small, slightly broader than long, cell wall smooth. Constriction deep, sinus linear. Semicells elongate hexagonal, angles slightly rounded, apex broadly truncate, straight or slightly retuse.

Size: Cell: 12µ-13µ × 11µ-12µ.; Isthmus: 4µ-5µ.

Occurrence: S1, S2

9. *Cosmarium abbreviatum* var. *planctonicum* West & G.S.West 1905. [fig. 24]

[West & West 1908, p. 85, pl. LXXI, f. 13]

Cells small, as long as broad or slightly broader, cell wall smooth. Constriction deep, sinus narrow, linear with dilated apex. Semi cells elongate hexagonal, upper angles more rounded, apex broadly truncate, straight or slightly convex.

Size: Cell: 20µ-21µ × 19µ-20µ; Isthmus: 5µ-6µ.

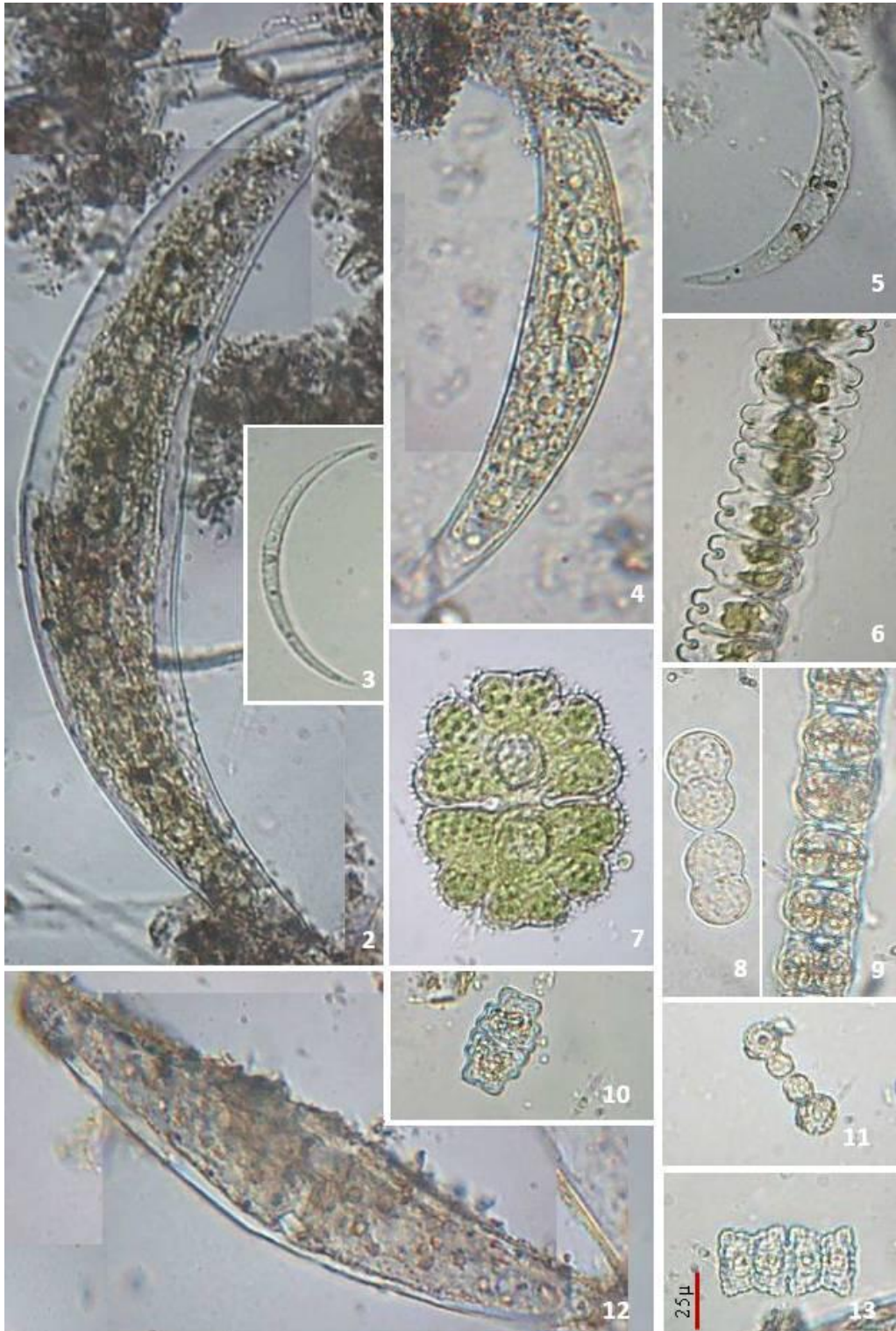
Occurrence: S12-S14

10. *Cosmarium angulosum* Brebisson 1856. [fig. 40]

Synonym: *Cosmarium meneghini* var. *angulosum* (Brebisson) Rabenhorst 1868.

[West & West 1908, p. 93, pl. LXXII, f. 35-36]

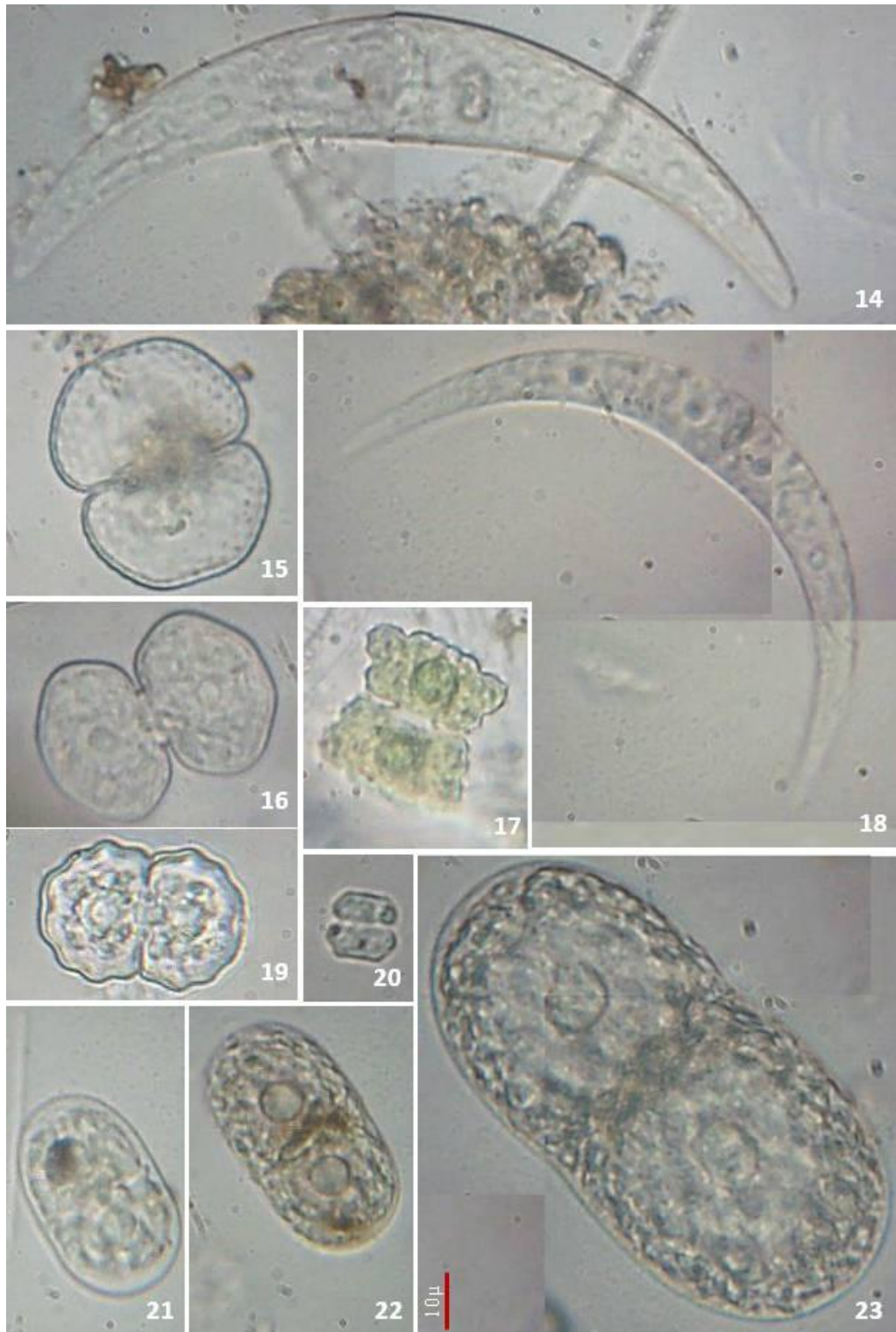
Cells small, 1.2 to 1.4 times longer than broad, cell wall smooth. Constriction deep, sinus narrow and linear. Semi cells sub rectangular, sides parallel or slightly diverged, apex broadly truncate, straight.



**Figures 2-13:** 2. *Closterium* species; 3. *Closterium parvulum* var. *angustum*, 4. *Closterium moniliferum*, 5. *Closterium parvulum*, 6. *Desmidium aptogonum*, 7. *Euastrum spinulosum*, 8. *Cosmarium globosum*, 9. *Desmidium baileyi*, 10. *Euastrum lacustre*, 11. *Cosmarium orbiculatum*, 12. *Closterium lunula* f. *minor*, 13. *Cosmarium divergens*.



- Size: Cell:  $15\mu\text{-}16\mu \times 20\mu\text{-}21\mu$ ; Isthmus:  $4\mu\text{-}5\mu$ .  
Occurrence: S1-S11, S15, S16, S19-S21
11. *Cosmarium bioculatum* Brebisson ex Ralfs 1848. [fig. 26]  
[West & West 1905, p. 165, pl. LXI, f. 3-7]  
Cells small, as long as broad, cell wall smooth. Constriction deep, sinus narrow towards apex and widen outwards. Semi cells oblong elliptic, sides rounded, base and apex flat.  
Size: Cell:  $20\mu\text{-}23\mu \times 20\mu\text{-}23\mu$ ; Isthmus:  $8\mu\text{-}9\mu$ .  
Occurrence: S14, S15
  12. *Cosmarium conspersum* var. *latum* (Brébisson) West & G.S.West 1912. [fig. 32]  
[West & West 1912, p. 15, pl. XCIX, f. 5, 6]  
Cells large, about 1.2 to 1.3 times as long as broad, cell wall granulate. Constriction deep, sinus narrow, linear and with dilated apex. Semi cells sub rectangular, sides sub parallel, slightly divergent, apex slightly convex. Granules uniform in size and arranged in vertical and oblique series.  
Size: Cell:  $80\mu\text{-}85\mu \times 95\mu\text{-}105\mu$ ; Isthmus:  $23\mu\text{-}26\mu$ .  
Occurrence: S1-S3, S5-S7, S14, S15
  13. *Cosmarium divergens* Willi Krieger 1932.[fig. 13, 17]  
[Suxena and Venkateswarlu 1966, p. 56, pl. III, f. 25]  
Cells small, about as long as broad, cell wall granulate. Constriction deep, sinus narrow and linear. Semi cells near rectangular, sides divergent, apex broader than base. Apex and margins crenate, small protuberance present on each sub cell.  
Size: Cell:  $26\mu\text{-}30\mu \times 26\mu\text{-}30$ ; Isthmus:  $7\mu\text{-}8\mu$ .  
Occurrence: S16-S21
  14. *Cosmarium globosum* Bulnheim 1861. [fig. 8]  
[West & West 1908, p. 64, pl. LXVIII, f. 1, 2]  
Cells small, near about 1.6 to 1.8 times as long as broad, cell wall punctuate (punctuations may or may not be clear). Semi cells semi circular, constriction shallow, acute, sinus widen.  
Size: Cell:  $25\mu\text{-}30\mu \times 38\mu\text{-}45\mu$ ; Isthmus:  $19\mu\text{-}21\mu$ .  
Occurrence: S16-S18
  15. *Cosmarium granatum* Brebisson ex Ralfs 1848. [fig. 29]  
[West & West 1905, p. 186, pl. LXIII, f. 1-4]  
Cells medium, near about 1.5 times as long as broad, cell wall punctuate. Semi cells pyramidate, constriction deep and linear with slightly dilated apex. Basal angles round to sub rectangular, sides at the base sub parallel, then converging to the apex, slightly concave-straight-slightly convex. Apex broadly rounded to straight.  
Size: Cell:  $30\mu\text{-}32\mu \times 44\mu\text{-}46\mu$ ; Isthmus:  $8\mu\text{-}10\mu$ .  
Occurrence: S2-S5, S8-S11
  16. *Cosmarium subgranatum* (Nordstedt) Lütkemüller 1902. [fig. 30]  
Synonym: *Cosmarium granatum* var. *subgranatum* Nordstedt 1878.  
[West & West 1905, p. 188, pl. LXIII, f. 5-8]  
Cells medium, near about 1.3 to 1.5 times as long as broad, cell wall punctuate. Semi cells pyramidate, constriction deep and linear with slightly dilated apex. Basal angles round to rectangular, sides at the base parallel or slightly diverged, then converging to the apex, undulate. Apex broadly rounded to straight.  
Size: Cell:  $24\mu\text{-}26\mu \times 32\mu\text{-}36\mu$ ; Isthmus:  $6\mu\text{-}7\mu$ .  
Occurrence: S11  
This is probably first report of the taxon from India.
  17. *Cosmarium hammeri* Reinsch 1866. [fig. 25]  
[West & West 1905, p. 181, pl. LXII, f. 20, 21]  
Cells medium sized, near about 1.2 to 1.3 times as long as broad, cell wall smooth. Semi cells truncate pyramidate, constriction deep and linear with slightly dilated apex. Basal angles rounded, upper part of sides converging to the apex, retuse. Apex straight or slightly retuse.  
Size: Cell:  $30\mu\text{-}35\mu \times 40\mu\text{-}45\mu$ ; Isthmus:  $8\mu\text{-}10\mu$ .  
Occurrence: S2, S3, S11, S13-S17, S19-S21
  18. *Cosmarium humile* Nordstedt ex De Toni 1889. [fig. 39]  
Synonym: *Euastrum humile* F.Gay 1884.  
[West & West 1908, p. 221, pl. LXXXV, f. 16-18]  
Cells small, near about 1.2 times as long as broad, cell wall slightly granular. Semi cells near rectangular, constriction deep and linear. Basal angle rounded, lower arms parallel or slightly divergent and retuse, upper arms angularly convergent, apex truncate and slightly undulate.  
Size: Cell:  $18\mu\text{-}20\mu \times 22\mu\text{-}24\mu$ ; Isthmus:  $5\mu\text{-}6\mu$ .  
Occurrence: S1-S3, S19, S20
  19. *Cosmarium impressulum* Elfving 1881. [fig. 19]  
Synonym: *Euastrum impressulum* (Elfving) F.Gay.  
[West & West 1908, p. 86, pl. LXXII, f. 14-18]  
Cells small, near about 1.4 to 1.5 times as long as broad, cell wall smooth. Semi cells sub semicircular, constriction deep and linear with slightly dilated apex. Basal angle rounded, entire margin undulate with 8 equal undulations.  
Size: Cell:  $24\mu\text{-}25\mu \times 33\mu\text{-}36\mu$ ; Isthmus:  $5\mu\text{-}6\mu$ .  
Occurrence: S10, S11, S19-S21
  20. *Cosmarium laeve* Rabenhorst 1868. [fig. 27]  
Synonym: *Euastrum laeve* (Rabenhorst) F.Gay.  
[West & West 1908, p. 99, pl. LXXIII, f. 8-19]  
Cells small, about 1.3 times as long as broad, cell wall smooth. Constriction deep, sinus narrow with a dilated apex. Semi cells elliptic to pyramidate, basal angles angularly round, lower arms parallel, straight, upper arms convergent, straight or slightly convex. Apex narrow, rounded with notch.  
Size: Cell:  $18\mu\text{-}20\mu \times 23\mu\text{-}26\mu$ ; Isthmus:  $5\mu\text{-}6\mu$ .  
Occurrence: S10, S11
  21. *Cosmarium margaritifera* f. *regularis* (Nordstedt) West & G.S.West 1908. [fig. 15]  
Basionym: *Cosmarium confusum* var. *regularis* Nordstedt 1887.



**Figures 14-23:** 14. *Closterium leibleinii*, 15. *Cosmarium margaritifera* f. *regularius*, 16. *Cosmarium pseudoprotuberans*, 17. *Cosmarium divergens*, 18. *Closterium parvulum*, 19. *Cosmarium impressulum*, 20. *Cosmarium abbreviatum*, 21. *Cylindrocystis crassa*, 22. *Cylindrocystis brebissonii* var. *turgida*, 23. *Actinotaenium diplosporum*.

- [West & West 1908, p. 199, pl. LXXXIII, f. 4-11]  
Cells medium sized, about 1.3 times as long as broad, cell wall granulate. Constriction deep, sinus narrow with a dilated apex, and slightly widen outwards. Semi cells truncate pyramidate, basal angles round, sides convergent, convex on lower part. Upper angles rounded apex truncate, straight.  
Size: Cell: 33 $\mu$ -36 $\mu$   $\times$  42 $\mu$ -45 $\mu$ ; Isthmus: 12 $\mu$ -14 $\mu$ .  
Occurrence: S4-S8, S12-S16, S20, S21
22. *Cosmarium meneghinii* Brebisson ex Ralfs 1848. [fig. 28]  
Syn: *Euastrum meneghinii* (Ralfs) F. Gay.  
[West & West 1908, p. 90, pl. LXXII, f. 29-32]  
Cells small, near about 1.4 to 1.5 times as long as broad, cell wall smooth. Semi cells rectangular in lower part and truncate pyramidate in upper part, constriction deep and linear with slightly dilated apex. Lower arms parallel, upper arms convergent, apex truncate, all the angle rounded, and all arms including apex retuse.  
Size: Cell: 15 $\mu$ -16 $\mu$   $\times$  21 $\mu$ -24 $\mu$ ; Isthmus: 3 $\mu$ -4 $\mu$ .  
Occurrence: S1, S13-S16
23. *Cosmarium moniliforme* Turpin ex Ralfs 1848.  
[West & West 1908, p. 20, pl. LXVII, f. 1-3]  
Cells small, about twice as long as broad, cell wall smooth. Semi cells circular, constriction deep, acute and widely open.  
Size: Cell: 18 $\mu$ -22 $\mu$   $\times$  40 $\mu$ -42 $\mu$ ; Isthmus: 8 $\mu$ -10 $\mu$ .  
Occurrence: S1, S3, S5-S8, S15, S16, S19-S21
24. *Cosmarium nitidulum* De Notaris 1867.  
Synonym: *Euastrum nitidulum* (De Notaris) F. Gay  
[West & West 1905, p. 197, pl. LXIV, f. 1-3]  
Cells medium sized, little longer than broad, cell wall rough. Semi cells truncate sub circular, constriction deep and linear with slightly dilated apex. Basal angles rounded, sides convex and converging to the apex, apex straight or slightly retuse.  
Size: Cell: 26 $\mu$ -28 $\mu$   $\times$  28 $\mu$ -30 $\mu$ ; Isthmus: 8 $\mu$ -9 $\mu$ .  
Occurrence: S2, S3, S18-S20
25. *Cosmarium orbiculatum* Ralfs ex Ralfs 1848. [fig. 11]  
[West & West 1908, p. 149, pl. LXXVII, f. 15-17]  
Cells small, about twice as long as broad, cell wall granulate. Semi cells circular, constriction deep, sinus wide open outside from acute apex.  
Size: Cell: 18 $\mu$   $\times$  35 $\mu$ ; Isthmus: 7 $\mu$ -8 $\mu$ .  
Occurrence: S19-S21  
This is probably first report of the taxon from India.
26. *Cosmarium porteanum* W. Archer 1860. [fig. 33]  
[West & West 1908, p. 165, pl. LXXX, f. 4-7]  
Cells medium sized, about 1.4 times as long as broad, cell wall granulate. Constriction deep, sinus broadly and gradually opens from rounded apex, isthmus slightly elongated. Semi cells elliptic, basal angles round, sides and apex convex.  
Size: Cell: 33 $\mu$ -36 $\mu$   $\times$  47 $\mu$ -50 $\mu$ ; Isthmus: 12 $\mu$ -14 $\mu$ .  
Occurrence: S10, S11, S15-S17, S19-S21
27. *Cosmarium pseudoprotuberans* O. Kirchner 1878. [fig. 16]  
[West & West 1908, p. 82, pl. LXXII, f. 6-8]  
Cells medium sized, about 1.3 times as long as broad, cell wall smooth. Semi cells elliptic hexagonal, constriction deep and open from obtuse apex. Lower arms divergent and straight, upper arms convergent and straight, apex truncate and straight. Basal angles and lateral angles rounded.  
Size: Cell: 30 $\mu$ -31 $\mu$   $\times$  32 $\mu$ -33 $\mu$ ; Isthmus: 10 $\mu$ -11 $\mu$ .  
Note: Slightly differ from taxa given by West & West, length of lower and upper arms similar, apex straight.  
Occurrence: S15
28. *Cosmarium quadratum* Ralfs ex Ralfs 1848. [fig. 38]  
Synonym: *Dysphinctium quadratum* (Ralfs) Hansgirg.  
[West & West 1908, p. 57, pl. LXX, f. 6-8]  
Cells medium sized, twice as long as broad, cell wall smooth. Semi cells sub quadrate, constriction deep and linear. Sides parallel first and then slightly convergent. Basal angles angularly rounded, apex convex rounded.  
Size: Cell: 15 $\mu$ -17 $\mu$   $\times$  30 $\mu$ -32 $\mu$ ; Isthmus: 4 $\mu$ -5 $\mu$ .  
Note: smaller than type in West and West.  
Occurrence: S8-S11
29. *Cosmarium rectangulare* Grunow 1868. [fig. 35]  
[West & West 1908, p. 54, pl. LXX, f. 1, 2]  
Cells medium sized, 1.4 times as long as broad, cell wall smooth. Semi cells sub hexagonal to reniform, constriction deep and linear with slightly dilated apex. Lower arms sub parallel and convex, upper arms convergent and straight, apex truncate and straight. Basal angles angularly rounded, lateral angles rounded.  
Size: Cell: 30 $\mu$ -32 $\mu$   $\times$  40 $\mu$ -42 $\mu$ ; Isthmus: 9 $\mu$ -10 $\mu$ .  
Occurrence: S15, S16  
This is probably first report of the taxon from Maharashtra.
30. *Cosmarium regnellii* Wille 1884. [Pl. XVII, F. 14]  
Synonym: *Cosmarium meneghinii* var. *regnellii* (Wille) Playfair.  
[West & West 1908, p. 90, pl. LXXII, f. 29-32]  
Cells small, about as long as broad, cell wall smooth. Semi cells elliptic hexagonal, constriction deep and linear with slightly dilated apex. Lower arms divergent, upper arms convergent, both retuse, apex truncate and straight. Basal angles angularly rounded, lateral angles rounded and produced.  
Size: Cell: 18 $\mu$ -22 $\mu$   $\times$  18 $\mu$ -22 $\mu$ ; Isthmus: 5 $\mu$ -6 $\mu$ .  
Occurrence: S1-S3, S15, S16, S19-S21
31. *Cosmarium sexangulare* P. Lundell 1871. [fig. 36]  
Synonym: *Cosmarium rectangulare* var. *sexangulare* (P. Lundell) Playfair; *Cosmarium sexangulare* f. *minima* Nordstedt 1887.  
[West & West 1908, p. 82, pl. LXXII, f. 4]  
Cells small, slightly longer than broad, cell wall smooth. Semi cells elliptic hexagonal, constriction deep and linear with slightly dilated apex. Lower arms divergent and straight,





**Figures 24-45:** 24. *Cosmarium abbreviatum* var. *planctonicum*, 25. *Cosmarium hammeri*, 26. *Cosmarium bioculatum*, 27. *Cosmarium laeve*, 28. *Cosmarium meneghini*, 29. *Cosmarium granatum*, 30. *Cosmarium subgranatum*, 31. *Cosmarium umbilicatum*, 32. *Cosmarium conspersum* var. *latum*, 33. *Cosmarium porteanum*, 34. *Cosmarium subspeciosum* var. *validius*, 35. *Cosmarium rectangulare*, 36. *Cosmarium sexangulare*, 37. *Cosmarium regnellii*, 38. *Cosmarium quadratum*, 39. *Cosmarium humile*, 40. *Cosmarium angulosum*, 41, 42. *Staurastrum* species, 43. *Staurastrum turgescens*, 44, 45. *Staurastrum tetracerum*,

upper arms convergent and retuse, apex truncate and straight. Basal angles angularly rounded, lateral angles angular and not produced.

Size: Cell:  $15\mu \times 18\mu$ ; Isthmus:  $4\mu-5\mu$ .

Occurrence: S1, S3, S9, S10, S20, S21

32. *Cosmarium subspeciosum* var. *validius* Nordstedt 1888. [fig. 34]

[West & West 1908, p. 253, pl. LXXXIX, f. 12, 13]

Cells large, about 1.5 times as long as broad, cell wall granulate. Constriction deep, sinus narrow, linear. Semi cells truncate pyramidate to sub semicircular, basal angles angularly round, sides gradually converge from convex lower side, apex truncate, straight. Entire margin and apex crenate.

Size: Cell:  $45\mu-48\mu \times 67\mu-71\mu$ ; Isthmus:  $18\mu-20\mu$ .

Occurrence: S12, S13, S15, S16

33. *Cosmarium umbilicatum* Lütkenmüller 1893. [fig. 31]

[West & West 1908, p. 88, pl. LXXII, f. 19-21]

Cells small, 1.2 to 1.3 times as long as broad, cell wall smooth. Semi cells angularly semicircular, constriction deep and linear with dilated apex. Angles rounded, lower arms divergent and retuse, upper arms convergent and undulate, apex truncate and retuse.

Size: Cell:  $18\mu-20\mu \times 24\mu-26\mu$ ; Isthmus:  $5\mu-6\mu$ .

Occurrence: In all sites

*Desmidium* C. Agardh ex Ralfs 1848.

34. *Desmidium aptogonum* Brébisson 1835. [fig. 6]

[Smith 1924, p. 144, pl. 88, f. 3 & 4]

Cells united to form long, spirally twisted filament enclosed in a gelatinous sheath. Cells medium sized, moderately constricted, isthmus very broad. Cells triangular with apices having semielliptical depression.

Size:  $42\mu-48\mu \times 22\mu-25\mu$ ; Isthmus:  $30\mu-34\mu$ .

Occurrence: S11, S12, S15-S19

35. *Desmidium baileyi* (Ralfs) Nordstedt 1880. [fig. 9]

Basionym: *Micrasterias baileyi* Ralfs.

[Smith 1924, p. 145, pl. 88, f. 5 - 7]

Cells united to form long, straight filament without gelatinous envelope. Cells small, median constriction not clear. Cells triangular with apices having semielliptical depression.

Size:  $33\mu-36\mu \times 22\mu-26\mu$ .

Occurrence: S18

*Euastrum* Ehrenberg ex Ralfs 1848.

36. *Euastrum lacustre* (Messikommer) Coesel 1984. [fig. 10]

Synonym: *Euastrum insulare* var. *lacustre* (Messikommer)

Willi Krieger 1937. [Coesel 1984]

Cells medium sized, about 1.7 times as long as broad, cell wall smooth. Semi cells near quadrangular, deeply incised, sinus narrow linear with dilated apex. Semicell three lobed, polar lobe rectangular with rounded angles and truncate retuse apex, lateral lobes short with rounded angles and

retuse margin. The retuse margin some time more incised and giving appearance of two more lobes.

Size: Cell:  $26\mu-28\mu \times 46\mu-48\mu$ ; Isthmus:  $9\mu-10\mu$ .

Occurrence: S10

37. *Euastrum spinulosum* Delponte 1876. [fig. 7]

[Delponte 1876, p. 97, pl. VI, f. 17, 18]

Cells large sized, about 1.2 times as long as broad, cell wall smooth. Semi cells semicircular to pyramidate, deeply incised, sinus narrow linear with dilated apex. Semi cells with two lateral and one terminal lobe. Lateral lobes round convex in outline, terminal lobe retuse, and margins spinulate. There is a protuberance on the face of the lobe. The central protuberance and lateral lobes have circles of granules, otherwise cell wall smooth.

Size: Cell:  $90\mu-97\mu \times 105\mu-115\mu$ ; Isthmus:  $18\mu-20\mu$ .

Occurrence: In all sites

*Staurastrum* Meyen ex Ralfs 1848.

38. *Staurastrum gracile* Ralfs 1848. [fig. 50]

[West et al., 1923, p. 96, pl. CXLIV, f. 3-7]

Cells medium sized, about 1.5 as broad as long including processes, cell wall smooth. Constriction slight, open, usually an acute notch. Semi cells cup shaped, lower angle rounded, laterals divergent and slightly notched. Apex convex, triangular, angles produced to form long arms. Arms broad at base and gradually narrow, straight or slightly convergent, provided with minute denticulations, tipped with 3 spines.

Size: Cell:  $40\mu-45\mu \times 29\mu-31\mu$  (with arms); Isthmus:  $8\mu-10\mu$ .

Occurrence: S11

39. *Staurastrum manfeldtii* Delponte 1878. [fig. 49]

[West et al., 1923, p. 96, pl. CXLIV, f. 3-7]

Cells medium sized, about 1.4 times as broad as long, cell wall smooth. Constriction slight, open, usually an acute notch. Semi cells cup shaped, lower angle rounded, laterals divergent and slightly notched. Apex straight or convex, triangular, angles produced to form long arms. Arms broad at base and gradually narrow, straight or slightly convergent, provided with several series of more pronounced denticulations, tipped with 3 spines. Denticulation also continued to cell apex.

Size: Cell:  $68\mu-72\mu \times 49\mu-52\mu$  (with arms); Isthmus:  $12\mu-14\mu$ .

Occurrence: S15

40. *Staurastrum margaritaceum* Meneghini ex Ralfs 1848. [fig. 48]

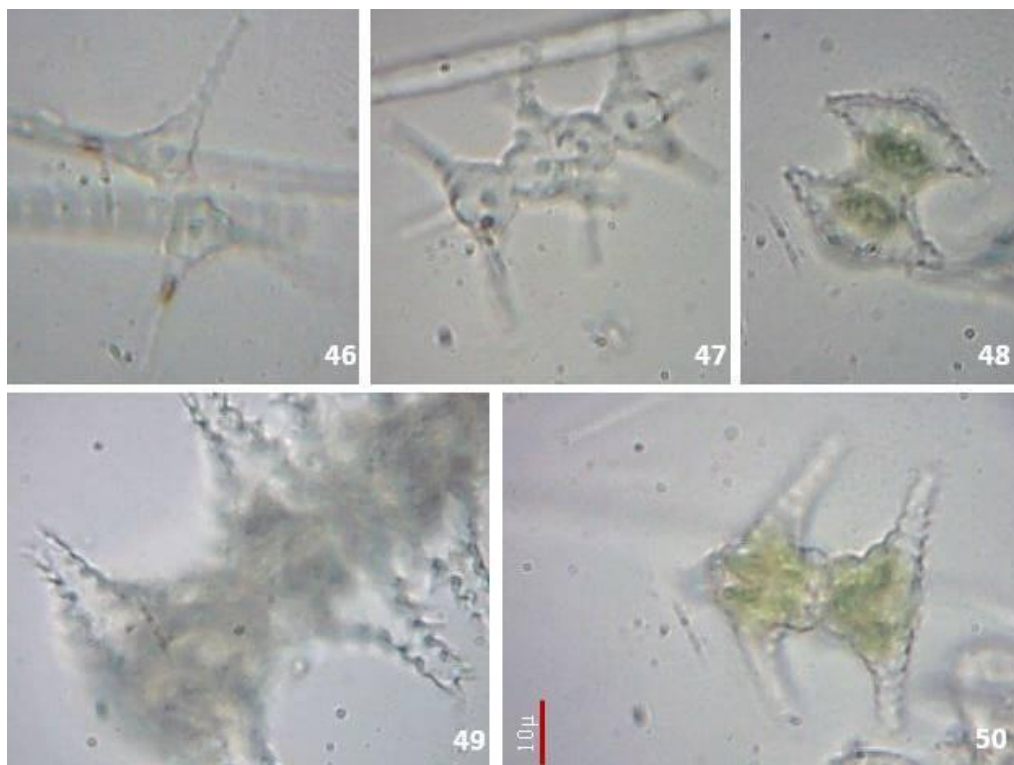
[West et al., 1923, p. 131, pl. CL, f. 5-9]

Cells small, about as broad as long, cell wall rough. Constriction slight and open, Semi cells cup shaped, or spindle shaped. Lower angle rounded, laterals divergent and straight. Apex convex, triangular, angles produced to form short arms, which are straight or slightly convergent, and provided with few series of granules,

Size: Cell:  $25\mu-28\mu \times 25\mu-28\mu$  (with arms); Isthmus:  $7\mu-9\mu$ .

Occurrence: S5-S7, S9, S10, S13, S14, S19-S21





Figures 46-50: 46. *Staurastrum tetracerum* var. *validum*, 47. *Staurastrum paradoxum* var. *parvum*, 48. *Staurastrum margaritaceum*, 49. *Staurastrum manfeldtii*, 50. *Staurastrum gracile*.

This is probably first report of the taxon from Maharashtra.

41. *Staurastrum paradoxum* var. *parvum* (West) N.Carter in West et al. 1923. [fig. 47]

Bas: *Staurastrum paradoxum* f. *parvum* West 1892.

[West et al., 1923, p. 101, pl. CXLV, f. 1-5]

Cells small, about 1.5 times as broad as long, constriction moderate and open from acute apex. Semi cells cup shaped, lower angle rounded, laterals divergent and straight. Apex flat, triangular, angles produced to form long arms, which are tapering and divergent. Arms with numerous series of denticulations and tipped with spines.

Size: Cell: 36µ-40µ X 24µ-28µ (with arms); Isthmus: 3µ-5µ.

Occurrence: S19-S21

This is probably first report of the taxon from India.

42. *Staurastrum tetracerum* Ralfs 1848. [fig. 44,45]

[West et al., 1923, p. 118, pl. CXLIX, f. 2,3]

Cells small, about as long as broad, flat or twisted. Constriction moderate, open, from acute apex. Semi cells near rectangular with divergent laterals and concave apex. Upper angles produced to form long and attenuated arms.

Size: Cell: 25µ-30µ × 25µ-30µ; Isthmus: 5µ-7µ.

Occurrence: In all sites

43. *Staurastrum tetracerum* var. *validum* West & G.S.West 1897. [fig. 46]

[West et al., 1923, p. 121, pl. CXLIX, f. 5]

Cells small, little longer than broad. Constriction moderate, open, from acute apex. Semi cells elongated rectangular with lower part of laterals straight and upper part divergent, apex concave. Upper angles produced to form long and attenuated arms.

Size: Cell: 11µ-14µ × 20µ-23µ, 38µ-42µ × 42µ-45µ (with arms) Isthmus: 3µ-5µ.

Occurrence: S1-S4, S12-S14, S19-S21

44. *Staurastrum turgescens* De Notaris 1867. [fig. 43]

Bas: *Cosmostrum turgescens* (De Notaris) Palamar-Mordvintseva 1982.

[West & West 1912, p. 167, pl. CXXVI, f. 5,6]

Cells small, little longer than broad, constriction deep and open from obtuse apex. Semi cells elliptic, angle rounded, apex straight or convex. Vertical view triangular, sides concave. Cell wall densely granular without proper disposition.

Size: Cell: 28µ-32µ × 35µ-38µ; Isthmus: 13µ-15µ.

Occurrence: S18-S21

This is probably first report of the taxon from Maharashtra.

45. *Staurastrum species* [fig. 41,42]

Cells medium sized, about 1.6 times as long as broad, cell wall granulate. Constriction moderate, sinus gradually opens

from acute apex, isthmus slightly elongated. Semi cells elliptic to sub circular.

Size: Cell: 22µ-24µ × 37µ-39µ; Isthmus: 14µ-15µ.

Occurrence: S1, S2, S4-S6, S12-S14

## References

- Agarkar, D. S., Agarkar, M. S. and Dikshit, R. 1979. Desmids from Bandhavgarh, Madhya Pradesh, India. *Hydrobiologia*, 65(3): 213-223.
- Agarkar, M. S. and Agarkar, D. S. 1977. Desmids from Pachmarhi, Madhya Pradesh, India. *Hydrobiologia*, 54(1): 23-32.
- Bharati, S. G., and Hegde, G. R. 1982. The genera *Staurstrum* Meyen and *Staurodesmus* Teil.(Desmidiaceae) in Karnataka and Goa States (India). *Hydrobiologia*, 96(1): 31-51.
- Coesel, P. F. 1984. Taxonomic implications of sem revealed cell wall sculpturing in some small-sized desmid species (chlorophyta, conjugatophyceae). *Acta botanica neerlandica*, 33(4): 385-398.
- Das, D. and Keshri, J. P. 2012a. Desmids from Manmecho (Mamencho) Lake, Eastern Himalaya. I. *NeBio*, 3(2): 37-44.
- Das, D. and Keshri, J. P. 2012b. Desmids from Manmecho (Mamencho) Lake, Eastern Himalaya. II. *NeBio*, 3(5): 11-19.
- Das, D. and Keshri, J. P. 2013a. Desmids of Khechiperi Lake, Sikkim Eastern Himalaya. *Algological Studies*, 143(1): 27-41.
- Das, D. and Keshri, J. P. 2013b. Desmids from South Sikkim, India. *Nelumbo*, 55: 172-180.
- Dhande, J. S. and Jawale, A. K. 2009. Genus *Cosmarium* Corda from Hartala Lake district Jalgaon Maharashtra. *Shodh, Samiksha aur Mulyankan*, 2(7): 196-198.
- Dwivedi, R. K., Shukla, C. P., Misra, P. K., Shukla, S. K. and Seth, M. K. 2009. On Desmids of Southern Himachal Pradesh of Indo-Western Himalaya. *Feddes Repertorium*, 120(3-4): 236-249.
- Hegde, G. R. 1986. Records of desmids new to Karnataka state-II Genus *Cosmarium* Corda. *Phykos*, 25: 123-128.
- Mallick, P. and Kesari, J. P. 2011. Contribution to the desmid flora of India II: genus *Cylindrocystis* Meneghini from West Bengal. *Bionature*, 31(2): 55-59.
- Patil, S. B. & Kumawat, D. A. 2014. Diversity of genus *Cosmarium* Corda Abhora dam Jalgaon district, Maharashtra. *International journal of geology, earth and Environmental sciences*, 4(1): 109-114.
- Patil, S. B. and Kumawat, D. A. 2015. Desmids from Abhora dam of Raver Tahsil of Jalgaon district, Maharashtra. *CIBTech Journal of Microbiology*, 4(1): 28-37.
- Shukla, S. K., Shukla, C. P. and Misra, P. K. 2008. Desmids (Chlorophyceae, Conjugales, Desmidiaceae) from Foothills of Western Himalaya, India. *Algae*, 23(1): 1-14.
- Sindhu, P. and Panikkar, M. V. N. 1995. Desmids new to Kerala, India-1. *Feddes Repertorium*, 106(3-4): 317-323.
- Smith, M. G. 1924. Phytoplankton of the Inland lakes of Wisconsin Part II. Wisconsin Geological Natural History Survey. *Bulletin*, 57.
- Suxena, M. R. and Venkateswarlu, V. 1966. Desmids of Andhra Pradesh, I. from Pakhal Lake, Warangal. *Hydrobiologia*, 28: 49-65.
- West, W. and West, G. S. 1904. A Monograph of the British Desmidiace Vol.-I. Ray society, London.
- West, W. and West, G. S. 1905. A Monograph of the British Desmidiace Vol.-II. Ray society, London.
- West, W. and West, G. S. 1908. A Monograph of the British Desmidiace Vol.-III. Ray society, London.
- West, W. and West, G. S. 1912. A Monograph of the British Desmidiace Vol.-IV. Ray society, London.
- West, W., West, G. S. and Carter, N. 1923. A Monograph of the British Desmidiace Vol.-V. Ray society, London.
- Yasmin, F., Buragohain, B. B. and Medhi, K.K. 2011. Planktonic Desmid Flora of South of the Eastern Himalayas: A Systematic Approach on Algae-I. *International Journal of Botany* 7(2): 154-161.