

Systematic account of Chlorococcales (Class: Chlorophyceae) from the Kole Lands of Thrissur, (part of Vembanad - Kol, Ramsar site), Kerala

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Abstract

The systematic account of thirty three taxa of the order Chlorococcales (Chlorophyceae) belonging to fifteen genera were described with their distribution in India, from the Kole lands of Thrissur district, part of Vembanad – Kol, a declared Ramsar site of Kerala. *Ankistrodesmus* (2), *Chlorella* (1), *Chlorococcum* (1), *Coelastrum* (3), *Dictyosphaerium* (1), *Dimorphococcus* (1), *Kirchneriella* (2), *Nephrocytium* (2), *Oocystis* (4), *Planktosphaeria* (1), *Schroederia* (1), *Selenastrum* (3), *Tetraedron* (9), *Tetralantos* (1) and *Westella* (1) are the genera (the number in parentheses indicate the number of taxa of each genus) collected during February 2005 to January 2006 from ten stations. *Planktosphaeria gelatinosa* G.M. Smith and *Tetraedron regulare* Kuetzing var. *torsum* (Turner) Brunthaler are new reports to Kerala.

Key words: Chlorococcales, Chlorophyceae, Kole lands of Thrissur, Vembanad – Kol, Ramsar site

Introduction

The Thrissur Kole lands are part of the Vembanad - Kol, a declared Ramsar site of Kerala. The present communication is a part of the investigation undertaken on the algal flora of the Kole lands of Thrissur district, Kerala (Paul, 2012) and this paper deals with the Chlorococcales (excluding *Pediastrum* and *Scenedesmus*) found in the Kole lands of Thrissur. Sixteen taxa of *Scenedesmus* (Paul and Sreekumar, 2012) and fifteen taxa of *Pediastrum* were reported (Paul and Sreekumar, 2011) from the Kole lands of Thrissur, Kerala. Philipose (1967), Jose and Patel (1992), Maya *et al.* (2000), John and Francis (2013), Tessy and Sreekumar (2009) and Arulmurugan *et al.* (2010) reported Chlorococcales from Kerala.

Philipose (1967), Chadha and Pandey (1978), Ashtekar and Kamat (1980), Freitas (1980), Patel *et al.* (1980), Singh and Saha (1982), Pandey *et al.* (1983), Sarma *et al.* (1983), Jha *et al.* (1985), Srivastava and Odhwani (1990), Habib (1996), Habib *et al.* (1998), Tarar and Bodkhe (1998), Habib and Chaturvedi (2001), Tiwari *et al.* (2001), Tiwari and Chauhan (2004), Deshmukh and Gunale (2007), Jena and Adhikary (2007), Shukla *et al.* (2007) and Andhale and Papdiwal (2010) reported Chlorococcales from different parts of India.

Materials and Methods

The surface water samples were collected monthly from ten stations namely Pullur (PR), Muriyad (MD), Nambiankavu (NK), Mapranam (MM), Chemmanda (CM), Cherpu (CP), Palakkal (PL), Chettupuzha (CT), Anthikkad (AK) and Enamavu (EM) during February 2005 to January 2006. The samples collected were preserved in 4% formalin solution. The Camera Lucida drawings were prepared and microphotographs of some taxa were also taken. The identifications were based on Philipose (1967) and Prescott (1982).

Results and Discussion

During the present study thirty-three taxa of Chlorococcales (excluding *Pediastrum* and *Scenedesmus*) have been collected and are described systematically with their distribution in India. The details regarding the locality and month of collection are given at the end of the description of each taxon.

Systematic Description:

Class: Chlorophyceae

Order: Chlorococcales

Family: Chlorococcaceae

1. ***Chlorococcum infusionum*** (Schrank) Meneghini (Pl. 1, Fig. 1)

Philipose, 1967. p. 73, fig. 1.

Cells 27.2-31.1 µm in diameter, spherical, solitary. Locality/Month: PR/Mar, May, Nov, Dec; NK/Mar, Apr, May.

Distribution in India: Kerala (Tessy and Sreekumar, 2009); Uttar Pradesh (Chadha and Pandey, 1978; Habib and Chaturvedi, 2001); Punjab (Sarma *et al.*, 1983); Maharashtra (Tarar and Bodkhe, 1998).

Family: **Characiaceae**

2. ***Schroederia planctonica*** (Skuja) Philipose (Pl. 1, Fig. 2)

Philipose, 1967. p. 90, figs. 18 a-g.

Cells spindle shaped with both ends drawn out into long spines, 70-97.3 µm long and 19.5-23.3 µm broad. Locality/Month: MM/Feb; PL/Mar, Jun.

Distribution in India: Kerala (Tessy and Sreekumar, 2009); Maharashtra (Ashtekar and Kamat, 1980; Freitas, 1980); Tamil Nadu (Philipose, 1967); Uttar Pradesh (Tiwari and Chauhan, 2004).

Family: **Hydrodictyaceae**

3. ***Tetraedron gracile*** (Reinsch) Hansgirg (Pl. 1, Fig. 3 & Pl. 2, Fig. 1)

Philipose, 1967. p. 154, figs. 69a-c.

Cells rectangular with the corners produced into narrow processes which branch twice and end in spines, cells without processes 19.5-30.2 µm and with processes 49.6-61.3 µm in diameter. Locality/Month: MD/Sep.

Distribution in India: Kerala (Philipose, 1967); West Bengal, Assam, Orissa, Karnataka (Philipose, 1967), Gujarat (Patel *et al.*, 1980); Uttar Pradesh (Habib, 1996; Habib and Chaturvedi, 2001); Uttaranchal (Habib *et al.*, 1998); Maharashtra (Deshmukh and Gunale, 2007).

4. ***Tetraedron limneticum*** Borge (Pl. 2, Fig. 2)

Philipose, 1967. p. 158, figs. 73a-d.

Cells tetragonal with the angles produced into processes having dichotomous branching, ultimate branchlets with 2-3 short spines, cells with processes 50.6-70 µm in diameter. Locality/Month: MD/Sep.

Distribution in India: Kerala, Orissa (Philipose, 1967); Uttar Pradesh (Pandey *et al.*, 1983); Rajasthan (Srivastava and Odhwani, 1990); Maharashtra (Deshmukh and Gunale, 2007).

5. ***T. muticum*** (A. Braun) Hansgirg (Pl. 1, Fig. 4)

Philipose, 1967. p. 137, fig. 51a, b.

Cells small, triangular, 27.2-30.2 µm in diameter, cell wall smooth. Locality/Month: MM/Mar.

Distribution in India: Kerala (John and Francis, 2013); West Bengal, Orissa, Madhya Pradesh, Andhra Pradesh (Philipose, 1967); Uttar Pradesh (Chadha and Pandey, 1978; Habib, 1996; Habib and Chaturvedi, 2001); Gujarat (Patel *et al.*, 1980); Maharashtra (Ashtekar and Kamat, 1980; Freitas, 1980; Tarar and Bodkhe, 1998); Himachal Pradesh (Jha *et al.*, 1985).

6. ***T. proteiforme*** (Turner) Brunthaler (Pl. 1, Fig. 5)

Philipose, 1967. p. 141, fig. 57.

Cells 31.1-38.9 µm in diameter, angles drawn out and ending in a long spine. Locality/Month: AK/Mar.

Distribution in India: Kerala (John and Francis, 2013).

7. ***T. regulare*** Kuetzing (Pl. 1, Figs. 6, 7, 8)

Philipose, 1967. p. 145, fig. 60 a-d, & f.

Cells 23.3-25.3 µm in diameter, angles with stout spine. Locality/Month: MM/Feb, Mar.

Distribution in India: Kerala, West Bengal, Andhra Pradesh, Assam, Orissa, Karnataka (Philipose, 1967); Gujarat (Patel *et al.*, 1980); Maharashtra (Freitas, 1980; Deshmukh and Gunale, 2007); Rajasthan (Srivastava and Odhwani, 1990); Uttaranchal (Habib *et al.*, 1998); Uttar Pradesh (Habib and Chaturvedi, 2001).

8. ***T. regulare*** Kuetzing var. ***torsum*** (Turner) Brunthaler (Pl. 1, Fig. 9)

Philipose, 1967. p. 146, figs. 60 g, j, k, m, n.

Cells 54.5 µm in diameter. Locality/Month: AK/Mar.

Distribution in India: Karnataka, Orissa, Tamil Nadu (Philipose, 1967); Maharashtra (Tarar and Bodkhe, 1998).

9. ***T. trigonum*** (Naegeli) Hansgirg forma ***crassum*** (Reinsch) De Toni (Pl. 1, Fig. 10 & Pl. 2, Fig. 3)

Philipose, 1967. p. 142, fig. 58 d-h.

Cells triangular, angles with a short spine, 23.3-25.3 µm in diameter. Locality/Month: PR/May; NK/Feb.

Distribution in India: Kerala (Tessy and Sreekumar, 2009); Orissa (Philipose, 1967); Maharashtra (Freitas, 1980); Punjab (Sarma *et al.*, 1983).

10. ***T. trigonum*** (Naegeli) Hansgirg forma ***gracile*** (Reinsch) De Toni (Pl. 1, Fig. 11)

Philipose, 1967. p. 144, fig. 58 a, b, p.

Cells 21.4-23.3 µm in diameter, angles with spine. Locality/Month: PR/Dec; MM/May.

Distribution in India: Kerala (Tessy and Sreekumar, 2009); West Bengal, Orissa, Tamil Nadu (Philipose, 1967).

11. ***T. trilobulatum*** (Reinsch) Hansgirg (Pl. 1, Fig. 12)

Philipose, 1967. p. 137, fig. 50.

Cells triangular, 19.5-21.4 µm in diameter, angles of cells broadly rounded. Locality/Month: PR/Sep.

Distribution in India: Kerala (Tessy and Sreekumar, 2009); Gujarat (Patel *et al.*, 1980); Maharashtra (Tara and Bodkhe, 1998).

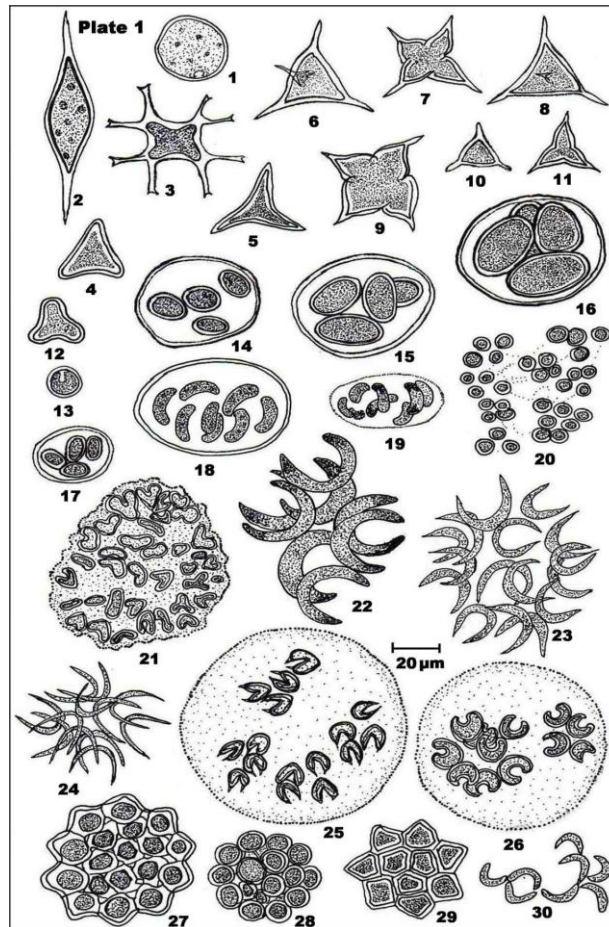


Plate 1 (Figs. 1-30):

1. *Chlorococcum infusionum* (Schrank) Meneghini; 2. *Schroederia planctonica* (Skuja) Philipose; 3. *Tetraedron gracile* (Reinsch) Hansgirg; 4. *T. muticum* (A. Braun) Hansgirg; 5. *T. proteiforme* (Turner) Brunnthaler; 6, 7 & 8. *T. regulare* Kuetzing; 9. *T. regulare* Kuetzing var. *torsum* (Turner) Brunnthaler; 10. *T. trigonum* (Naegeli) Hansgirg forma *crassum* (Reinsch) De Toni; 11. *T. trigonum* (Naegeli) Hansgirg forma *gracile* (Reinsch) De Toni; 12. *T. trilobatum* (Reinsch) Hansgirg; 13. *Chlorella vulgaris* Beijerinck; 14. *Oocystis borgei* Snow; 15. *O. elliptica* W. West; 16. *O. gigas* Archer; 17. *O. pusilla* Hansgirg; 18. *Nephrocytium agardhianum* Naegeli; 19. *N. lunatum* W. West; 20. *Westella botryoides* (W. West) de Wildeman; 21. *Dimorphococcus lunatus* A. Braun; 22. *Selenastrum bibraianum* Reinsch; 23. *S. gracile* Reinsch; 24. *S. westii* G.M. Smith; 25. *Kirchneriella lunaris* (Kirchner) Moebius; 26. *K. obesa* (W. West) Schmidle; 27. *Coelastrum cambricum* Archer var. *intermedium* (Bohlin) G.S. West; 28. *C. microporum* Naegeli; 29. *C. sphaericum* Naegeli; 30. *Tetralantus lagerheimii* Teiling.

Family: **Oocystaceae**

12. ***Chlorella vulgaris*** Beijerinck (Pl. 1, Fig. 13 & Pl. 2, Fig. 4)

Philipose, 1967. p. 173, fig. 82.

Cells solitary or in small colonies, spherical, 9.7-11.7 µm in diameter, chloroplast cup-shaped. Locality/Month: PR/Nov; NK/Feb; MM/Jun; CP/Jun; CT/Mar, Jun; AK/May, Jul, Aug, Sep.

Distribution in India: Kerala (Maya *et al.*, 2000; Tessy and Sreekumar, 2009; Arulmurugan *et al.*, 2010); Orissa (Philipose, 1967); Uttar Pradesh (Chadha and Pandey, 1978; Tiwari *et al.*, 2001; Tiwari and Chauhan, 2004); Maharashtra (Ashtekar and Kamat, 1980; Freitas, 1980; Tara and Bodkhe, 1998; Deshmukh and Gunale, 2007); Bihar (Singh and Saha, 1982); Himachal Pradesh (Jha *et al.*, 1985); West Bengal, Orissa (Jena and Adhikary, 2007).

13. ***Planktosphaeria gelatinosa*** G.M. Smith (Pl. 2, Fig. 5)

Prescott, 1982. p. 240, pl. 53, fig. 23.

Free floating colony of spherical cells grouped within a mucilaginous envelope, cells 12.6-18.5 µm in diameter. Locality/Month: MD/Jun; NK/Jun, Jul.

Distribution in India: Maharashtra (Deshmukh and Gunale, 2007).

14. ***Oocystis borgei*** Snow (Pl. 1, Fig. 14)
Philipose, 1967. p. 183, fig. 93.
Colonies 4 celled, 43.8-54.5 µm in diameter, enclosing envelope round, cells ellipsoid, 9.7-11.7 µm in diameter, 10.7-12.6 µm long. Locality/Month: MD/Jan.
Distribution in India: Kerala, West Bengal, Andhra Pradesh, Orissa, Tamil Nadu (Philipose, 1967); Uttar Pradesh (Chadha and Pandey, 1978); Punjab (Sarma *et al.*, 1983); Rajasthan (Srivastava and Odhwani, 1990); Maharashtra (Andhale and Papdiwal, 2010).
 15. ***O. elliptica*** W. West (Pl. 1, Fig. 15)
Philipose, 1967. p. 186, fig. 100.
Colonies 4 celled, 50.6-62.2 µm in diameter with the envelope, cells 7.8-12.6 µm broad and 20.4-24.3 µm long. Locality/Month: NK/Nov.
Distribution in India: Kerala (Philipose, 1967; John and Francis, 2013); Maharashtra (Ashtekar and Kamat, 1980; Tarar and Bodkhe, 1998; Deshmukh and Gunale, 2007); Uttar Pradesh (Pandey *et al.*, 1983; Habib, 1996, Shukla *et al.*, 2007).
 16. ***O. gigas*** Archer (Pl. 1, Fig. 16)
Philipose, 1967. p. 183, fig. 94a.
Colonies 4 celled, 54.5-73.9 µm in diameter, envelope round, cells ellipsoid, longer than broad, 25.3-29.2 µm in diameter and 35-42.8 µm long. Locality/Month: CT/Mar.
Distribution in India: Kerala (John and Francis, 2013); Maharashtra (Tarar and Bodkhe, 1998); Uttaranchal (Habib *et al.*, 1998); Uttar Pradesh (Habib and Chaturvedi, 2001).
 17. ***O. pusilla*** Hansgirg (Pl. 1, Fig. 17)
Prescott, 1982. p. 246, pl. 51, fig. 15, pl. 54, figs. 4, 5.
Colony of 4 cells, 27.2-32.1 µm in diameter, cells oval, 5.8-7.8 µm in diameter 8.8-11.7 µm long. Locality/Month: MM/Mar.
Distribution in India: Kerala (John and Francis, 2013); Maharashtra (Ashtekar and Kamat, 1980; Tarar and Bodkhe, 1998; Deshmukh and Gunale, 2007).
 18. ***Nephrocytium agardhianum*** Naegeli (Pl. 1, Fig. 18 & Pl. 2, Fig. 6)
Philipose, 1967. p. 189, fig. 104.
Colonies oval, 34-40.9 µm broad, 52.5-66.1 µm long, 8 cells within a gelatinous envelope, cells reniform with round ends, 4.9-6.8 µm broad, 18.5-24.3 µm long. Locality/Month: PR/Oct, Jan; NK/Sep; CP/May.
Distribution in India: Kerala (Philipose, 1967; John and Francis, 2013; Tessy and Sreekumar, 2009); Andhra Pradesh, Orissa (Philipose, 1967); Uttaranchal (Habib *et al.*, 1998); Uttar Pradesh (Habib and Chaturvedi, 2001).
 19. ***N. lunatum*** W. West (Pl. 1, Fig. 19 & Pl. 2, Fig. 7)
Philipose, 1967. p. 189, fig. 103.
Colonies with 8 cells, envelope gelatinous, 18.5-26.3 µm broad, 43.8-58.4 µm long, cells 3.9-5.8 µm broad, 12.6-18.5 µm long. Locality/Month: CT/Jun.
Distribution in India: Kerala (John and Francis, 2013); West Bengal (Philipose, 1967); Uttaranchal (Habib *et al.*, 1998); Uttar Pradesh (Habib and Chaturvedi, 2001); Maharashtra (Deshmukh and Gunale, 2007).
- Family: **Dictyosphaeriaceae**
20. ***Dictyosphaerium ehrenbergianum*** Naegeli (Pl. 2, Fig. 8)
Philipose, 1967. p. 201, fig. 111.
Colonies ovoid with 32 cells, 67-85.6 µm in diameter, cells ovoid to spherical, 3.9-6.8 µm broad, 5.8-11.7 µm long. Locality/Month: AK/Jun.
Distribution in India: Kerala (John and Francis, 2013); West Bengal, Orissa, Karnataka, Tamil Nadu (Philipose, 1967); Maharashtra (Freitas, 1980; Deshmukh and Gunale, 2007).
 21. ***Westella botryoides*** (W. West) de Wildeman (Pl. 1, Fig. 20)
Philipose, 1967. p. 203, fig. 114.
Colonies of irregular shape, 41.8-61.3 µm in diameter, cells small, spherical, 2.9-7.8 µm in diameter. Locality/Month: NK/Jul.
Distribution in India: Kerala (Jose and Patel, 1992); West Bengal, Orissa (Philipose, 1967); Maharashtra (Ashtekar and Kamat, 1980; Freitas, 1980); Himachal Pradesh (Jha *et al.*, 1985).
 22. ***Dimorphococcus lunatus*** A. Braun (Pl. 1, Fig. 21 & Pl. 2, Fig. 9)
Philipose, 1967. p. 205, fig. 115.
Colonies 70-85.6 µm in diameter, outer cells reniform, inner cells ovoid, cells 5.8-13.6 µm broad, 10.7-20.4 µm long. Locality/Month: PR/May, Sep, Oct, Jan; MD/Aug-Oct; MM/Oct; CM/-May, Jun, Aug- Oct; CP/Jul; PL/Sep; CT/Aug, Sep.

Distribution in India: Kerala (Philipose, 1967; Tessa and Sreekumar, 2009); Assam, Orissa, Andhra Pradesh, Karnataka (Philipose, 1967); Maharashtra (Freitas, 1980); Bihar (Singh and Saha, 1982); Uttar Pradesh (Habib and Chaturvedi, 2001).

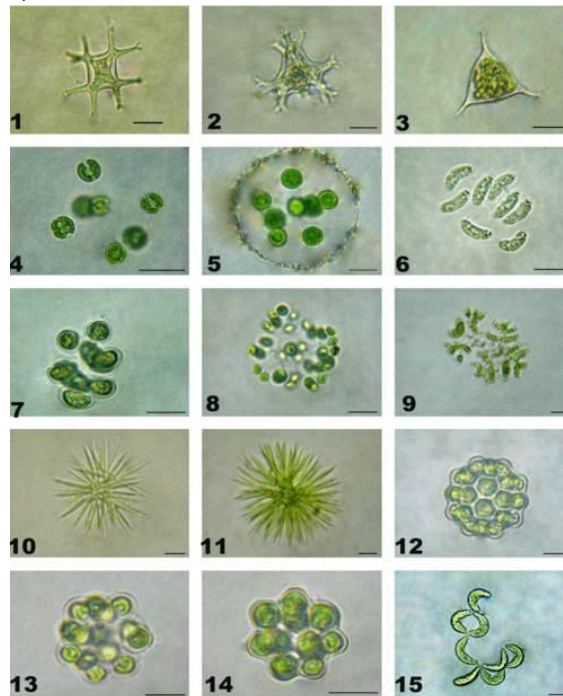


Plate 2 (Figs. 1-15):

1. *Tetraedron gracile* (Reinsch) Hansgirg; 2. *T. limneticum* Borge; 3. *T. trigonum* (Naegeli) Hansgirg forma *crassum* (Reinsch) De Toni; 4. *Chlorella vulgaris* Beijerinck; 5. *Planktosphaeria gelatinosa* G.M. Smith; 6. *Nephrocytium agardhianum* Naegeli; 7. *N. lunatum* W. West; 8. *Dictyosphaerium ehrenbergianum* Naegeli; 9. *Dimorphococcus lunatus* A. Braun; 10. *Ankistrodesmus falcatus* (Corda) Ralfs var. *radiatus* (Chodat) Lemmermann; 11. *A. spiralis* (Turner) Lemmermann var. *fasciculatus* G.M. Smith; 12. *Coelastrum cambricum* Archer var. *intermedium* (Bohlin) G.S. West; 13. *C. microporum* Naegeli; 14. *C. sphaericum* Naegeli; 15. *Tetrallantos lagerheimii* Teiling.

Family: **Selenastraceae**

23. ***Ankistrodesmus falcatus*** (Corda) Ralfs var. ***radiatus*** (Chodat) Lemmermann (Pl. 2, Fig. 10)
Philipose, 1967. p. 213, fig. 121 d.
Cells acicular with the ends tapering to acute apices, 2-2.9 μm broad and 68.1-75.9 μm long with tapering ends. Locality/Month: MD/May, Jun; MM/Jan; CP/Sep; CT/Feb.
Distribution in India: Kerala (John and Francis, 2013); Orissa (Philipose, 1967; Jena and Adhikary, 2007); Maharashtra (Andhale and Papdiwal, 2010).
24. ***A. spiralis*** (Turner) Lemmermann var. ***fasciculatus*** G.M. Smith (Pl. 2, Fig. 11)
Philipose, 1967. p. 211, fig. 119 d.
Cells 2.9-4.9 μm broad and 53.5-68.1 μm long. Locality/Month: MD/Aug, Sep, Oct; NK/Mar, May, Jul, Aug, Dec; MM/Jul, Jan; CP/Jul; AK/Mar, Jul.
Distribution in India: Kerala (Philipose, 1967; John and Francis, 2013); Assam, Orissa, Karnataka, West Bengal (Philipose, 1967); Maharashtra (Deshmukh and Gunale, 2007; Andhale and Papdiwal, 2010).
25. ***Selenastrum bibraianum*** Reinsch (Pl. 1, Fig. 22)
Philipose, 1967. p. 219, fig. 127.
Cells in colonies, sickle shaped with pointed ends, 23.3-31.1 μm long and 5.8-7.8 μm broad. Locality/Month: CT/Sep.
Distribution in India: Kerala (John and Francis, 2013); Orissa, Karnataka (Philipose, 1967); Gujarat (Patel *et al.*, 1980); Maharashtra (Freitas, 1980; Deshmukh and Gunale, 2007; Andhale and Papdiwal, 2010); Bihar (Singh and Saha, 1982); Himachal Pradesh (Jha *et al.*, 1985); Uttar Pradesh (Habib and Chaturvedi, 2001).
26. ***S. gracile*** Reinsch (Pl. 1, Fig. 23)
Philipose, 1967. p. 219, fig. 128.
Cells 4.9-5.8 μm broad and 19.5-27.2 μm long, sickle shaped, lunate, apices of cells acute. Locality/Month: PR/May, Oct, Jan; MD/Sep, Oct; NK/May-Jul, Dec; MM/Oct; CP/Jul.
Distribution in India: Kerala (Philipose, 1967; Tessa and Sreekumar, 2009); West Bengal, Orissa, Assam, Madhya Pradesh, Karnataka (Philipose, 1967); Maharashtra (Freitas, 1980; Tarar and Bodkhe, 1998); Bihar

- (Singh and Saha, 1982); Uttar Pradesh (Pandey *et al.*, 1983; Shukla *et al.*, 2007); Rajasthan (Srivastava and Odhwani, 1990); Uttaranchal (Habib *et al.*, 1998).
27. ***S. westii*** G.M. Smith (Pl. 1, Fig. 24)
Philipose, 1967. p. 221, fig. 129.
Cells lunate with acuminate apices, 2-2.9 μm broad and 23.3-25.3 μm long. Locality/Month: PR-Feb, Jan; MD-Oct; CM-Mar, Apr, Sep, Oct; PL-Mar, Jun, Sep, Oct; CT-Sep, Oct.
Distribution in India: Kerala (Philipose, 1967; Tessy and Sreekumar, 2009); Maharashtra (Freitas, 1980; Tarar and Bodkhe, 1998).
28. ***Kirchneriella lunaris*** (Kirchner) Moebius (Pl. 1, Fig. 25)
Philipose, 1967. p. 222, fig. 131.
Colonies spherical with a gelatinous envelope, 66.1-81.7 μm in diameter, cells crescent shaped with pointed ends, 4.9-5.8 μm broad and 10.7-13.6 μm long. Locality/Month: PR/Aug, Jan; MD/Oct; PL/Jun, Oct.
Distribution in India: Kerala (Philipose, 1967; Maya *et al.*, 2000; Tessy and Sreekumar, 2009; Arulmurugan *et al.*, 2010; John and Francis, 2013); Assam, Orissa, Andhra Pradesh, Karnataka, Tamil Nadu, West Bengal, Bihar (Philipose, 1967); Gujarat (Patel *et al.*, 1980); Maharashtra (Ashtekar and Kamat, 1980; Deshmukh and Gunale, 2007); Bihar (Singh and Saha, 1982).
29. ***K. obesa*** (W. West) Schmidle (Pl. 1, Fig. 26)
Philipose, 1967. p. 224, fig. 132.
Colonies spherical with a gelatinous envelope, 52.5-76.8 μm in diameter, cells lunate with rounded apices, 4.9-6.8 μm broad and 7.8-14.6 μm long. Locality/Month: NK/Jul, Sep, Dec.
Distribution in India: Kerala (Philipose, 1967; John and Francis, 2013); Orissa, (Philipose, 1967); Maharashtra (Freitas, 1980); Rajasthan (Srivastava and Odhwani, 1990); Uttar Pradesh (Tiwari *et al.*, 2001; Tiwari and Chauhan, 2004); Assam (Jena and Adhikary, 2007).

Family: **Coelastraceae**

30. ***Coelastrum cambricum*** Archer var. ***intermedium*** (Bohlin) G.S. West (Pl. 1, Fig. 27 & Pl. 2, Fig. 12)
Philipose, 1967. p. 231, fig. 138b.
Colonies 58.4-77.8 μm in diameter, cells 11.7-16.5 μm in diameter, intercellular spaces triangular. Locality/Month: PR/May, Sep, Oct; MD/Aug-Oct; NK/Mar, Jul, Aug, Jan; MM/Oct, Jan; CM/Feb, Mar, Sep, Jan; CP/Jul, Sep, Nov; CT/Aug, Oct; EM/Jul.
Distribution in India: Kerala (Philipose, 1967; Tessy and Sreekumar, 2009; John and Francis, 2013); Andhra Pradesh, Orissa, Karnataka, West Bengal (Philipose, 1967); Maharashtra (Ashtekar and Kamat, 1980; Freitas, 1980; Tarar and Bodkhe, 1998; Andhale and Papdiwal, 2010); Bihar (Singh and Saha, 1982).
31. ***C. microporum*** Naegeli (Pl. 1, Fig. 28 & Pl. 2, Fig. 13)
Philipose, 1967. p. 228, fig. 135.
Colonies spherical, 35-46.7 μm in diameter, cells spherical with small intercellular spaces, 6.8-11.7 μm in diameter. Locality/Month: PR-Jun-Sep, Dec, Jan; MD-Jul; PL-Sep.
Distribution in India: Kerala (Philipose, 1967; Maya *et al.*, 2000; Tessy and Sreekumar, 2009; Arulmurugan *et al.*, 2010; John and Francis, 2013); Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Orissa, Tamil Nadu, West Bengal, (Philipose, 1967); Uttar Pradesh (Chadha and Pandey, 1978; Pandey *et al.*, 1983; Habib and Chaturvedi, 2001; Tiwari and Chauhan, 2004; Shukla *et al.*, 2007); Gujarat (Patel *et al.*, 1980); Maharashtra (Ashtekar and Kamat, 1980; Tarar and Bodkhe, 1998; Deshmukh and Gunale, 2007; Andhale and Papdiwal, 2010); Bihar (Singh and Saha, 1982); Himachal Pradesh (Jha *et al.*, 1985); Rajasthan (Srivastava and Odhwani, 1990); Uttaranchal (Habib *et al.*, 1998).
32. ***C. sphaericum*** Naegeli (Pl. 1, Fig. 29 & Pl. 2, Fig. 14)
Philipose, 1967. p. 229, fig. 136.
Colony 32.1-39.9 μm in diameter, cells regularly arranged, 6.8-11.7 μm in diameter. Locality/Month: NK-Jul.
Distribution in India: Kerala (John and Francis, 2013); Maharashtra (Deshmukh and Gunale, 2007).

Family: **Scenedesmaceae**

33. ***T. lagerheimii*** Teiling (Pl. 1, Fig. 30 & Pl. 2, Fig. 15)
Philipose, 1967. p. 291, fig. 188.
Colonies 8 celled, 3.9-5.8 μm broad, 16.5-25.2 μm long. Locality/Month: CM/Apr.
Distribution in India: Kerala (Philipose, 1967; Tessy and Sreekumar, 2009); West Bengal, Orissa, Karnataka, Punjab (Philipose, 1967).

The Chlorococcalean taxa has more diversity in Pullur, Muriyad and Nambiankavu. In these stations (stations 1, 2 & 3) twelve taxa were found followed by Mapranam (Station 4) with eleven taxa. The seasonal biodiversity analysis in the study area showed that twenty-one taxa of Chlorococcales were found during monsoon (Jun-Sep), nineteen during pre-monsoon (Feb-May) and fifteen during post-monsoon (Oct-Jan) season (Table 1). The variations in rainfall and the hydrographic parameters are responsible for the fluctuations of algal

diversity in the Kole lands of Thrissur, Kerala (Paul and Sreekumar, 2013). *Planktosphaeria gelatinosa* G.M. Smith and *Tetraedron regulare* Kuetzing var. *torsum* (Turner) Brunthaler are new reports to the algal flora of Kerala.

Table: 1 Seasonal and spatial variation of the diversity of Chlorococcales

Sl. No:	Name of taxa	SEASONS			STATIONS									
		S	S	S	1	2	3	4	5	6	7	8	9	10
		i	ii	iii										
1	<i>Ankistrodesmus falcatus</i> var. <i>radiatus</i>	+	+	+	-	+	-	+	-	+	-	+	-	-
2	<i>A. spiralis</i> var. <i>fasciculatus</i>	+	+	+	-	+	+	+	-	+	-	-	+	-
3	<i>Chlorella vulgaris</i>	+	+	+	+	-	+	+	-	+	-	+	+	-
4	<i>Chlorococcum infusionum</i>	+	-	+	+	-	+	-	-	-	-	-	-	-
5	<i>Coelastrum cambricum</i> var. <i>intermedium</i>	+	+	+	+	+	+	+	+	+	-	+	-	+
6	<i>C. microporum</i>	-	+	+	+	+	-	-	-	-	+	-	-	-
7	<i>C. sphaericum</i>	-	+	-	-	-	+	-	-	-	-	-	-	-
8	<i>Dictyosphaerium ehrenbergianum</i>	-	+	-	-	-	-	-	-	-	-	-	+	-
9	<i>Dimorphococcus lunatus</i>	+	+	+	+	+	-	+	+	+	+	+	-	-
10	<i>Kirchneriella lunaris</i>	-	+	+	+	+	-	-	-	-	+	-	-	-
11	<i>K. obesa</i>	-	+	+	-	-	+	-	-	-	-	-	-	-
12	<i>Nephrocystium agardhianum</i>	+	+	+	+	-	+	-	-	+	-	-	-	-
13	<i>N. lunatum</i>	-	+	-	-	-	-	-	-	-	-	+	-	-
14	<i>Oocystis borgei</i>	-	-	+	-	+	-	-	-	-	-	-	-	-
15	<i>O. elliptica</i>	-	-	+	-	-	+	-	-	-	-	-	-	-
16	<i>O. gigas</i>	+	-	-	-	-	-	-	-	-	-	+	-	-
17	<i>O. pusilla</i>	+	-	-	-	-	-	+	-	-	-	-	-	-
18	<i>Planktosphaeria gelatinosa</i>	-	+	-	-	+	+	-	-	-	-	-	-	-
19	<i>Schroederia planctonica</i>	+	+	-	-	-	-	+	-	-	+	-	-	-
20	<i>Selenastrum bibraianum</i>	-	+	-	-	-	-	-	-	-	-	+	-	-
21	<i>S. gracile</i>	+	+	+	+	+	+	+	-	+	-	-	-	-
22	<i>S. westii</i>	+	+	+	+	+	-	-	+	-	+	+	-	-
23	<i>Tetraedron gracile</i>	-	+	-	-	+	-	-	-	-	-	-	-	-
24	<i>T. limneticum</i>	-	+	-	-	+	-	-	-	-	-	-	-	-
25	<i>T. muticum</i>	+	-	-	-	-	-	+	-	-	-	-	-	-
26	<i>T. proteiforme</i>	+	-	-	-	-	-	-	-	-	-	-	+	-
27	<i>T. regulare</i>	+	-	-	-	-	-	+	-	-	-	-	-	-
28	<i>T. regulare</i> var. <i>torsum</i>	+	-	-	-	-	-	-	-	-	-	-	+	-
29	<i>T. trigonum</i> forma <i>crassum</i>	+	-	-	+	-	+	-	-	-	-	-	-	-
30	<i>T. trigonum</i> forma <i>gracile</i>	+	-	+	+	-	-	+	-	-	-	-	-	-
31	<i>T. trilobatum</i>	-	+	-	+	-	-	-	-	-	-	-	-	-
32	<i>Tetralantos lagerheimii</i>	+	-	-	-	-	-	-	+	-	-	-	-	-
33	<i>Westella botryoides</i>	-	+	-	-	-	+	-	-	-	-	-	-	-
Number of taxa		19	21	15	12	12	12	11	4	7	5	8	5	1

+ Present, - Absent, S i - pre-monsoon season (Feb - May), S ii - monsoon season (Jun - Sep), S iii - post-monsoon season (Oct - Jan). **Stations:** (1) Pullur, (2) Muriyad, (3) Nambiankavu, (4) Mapranam, (5) Chemmunda, (6) Cherpu, (7) Palakkal, (8) Chettupuzha, (9) Anthikkad, (10) Enamavu

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