RESEARCH ARTICLE

Biodiversity of the genus *Oedogonium* Link ex Hirn 1900 in Raigad District, Maharashtra, India

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ABSTRACT

In this paper, the biodiversity of the genus *Oedogonium* Link ex Hirn 1900 in Raigad district was studied. During the study of filamentous green algae of Raigad district, 18 taxa of *Oedogonium* Link ex Hirn were recorded. Of these one species *Oedogonium boscii* var. notabile is probably recorded for the first time in India.

Keywords: *Oedogonium*, biodiversity, Raigad district

INTRODUCTION

The Raigad District formerly known as the Kolaba District lies between 17° 51' to 19° 80' north latitudes and 72° 51' to 73° 40' east longitudes. Raigad is located in south western side of Maharashtra State. (Kolaba District Gazetteer, 1964; http://raigad.nic.in/htmldocs/overview.htm; http://raigad.nic.in/htmldocs/geography.htm)

The average maximum temperature in the district is 40.4 °C and the average minimum temperature is 16.1 °C.
(http://raigad.nic.in/htmldocs/overview.htm)

The climate of this district is typical of that on the west coast of India, with plentiful and regular rainfall in the season from June to September and hot and humid weather in the summer season which is in the months from March to May. October and November form the post-monsoon or the retreating monsoon season. The period from December to February is the winter or cold season. The average annual rainfall is 3884.3 mm. (Kolaba District Gazetteer, 1964; http://raigad.nic.in/htmldocs/overview.htm) Gonzalves (1981) has carried out extensive studies on the *Oedogonium* of this region along with the *Oedogonium* of Mumbai and Thane. There is very little information available about the current status of algal flora of this region. The present study was undertaken to study the biodiversity of the genus *Oedogonium* in this region. A total of 18 taxa of *Oedogonium* were collected and identified from Northern part of Raigad district.

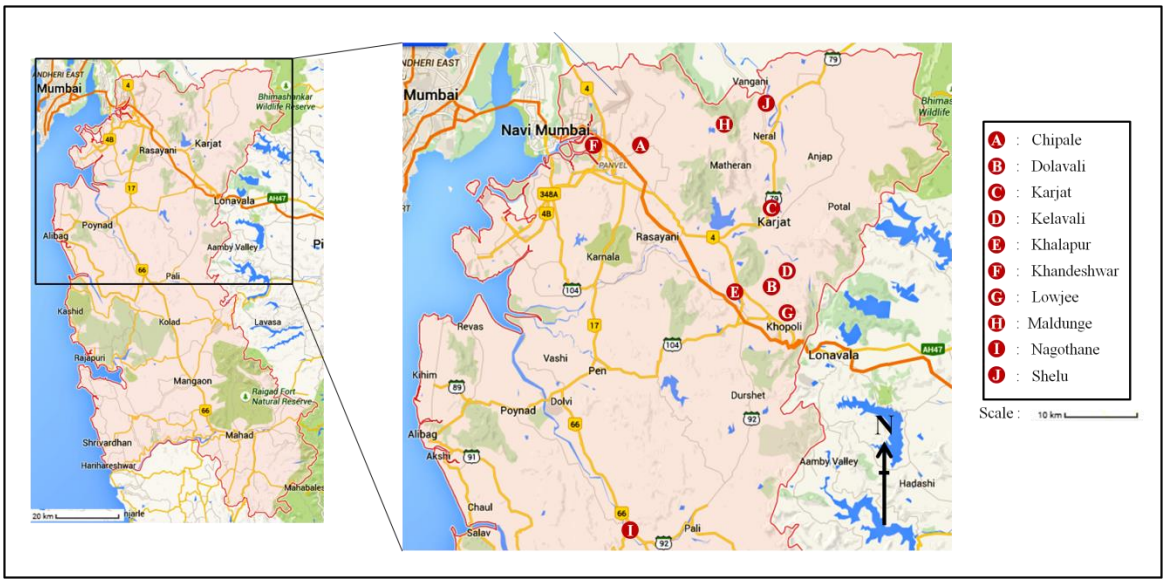

Figure 1: Map showing sites from Raigad District where *Oedogonium* Link ex Hirn was found
The red line indicates the boundary of Raigad district. The red dots indicate the places of collection. The arrow indicates North.

MATERIALS AND METHODS

Collection of Algae: The samples of algae were collected from various permanent and temporary sources of freshwater in some selected areas in Northern part of Raigad District. The samples were collected in small plastic containers with the help of forceps, scalpels etc. The samples were given 'Collection Codes' based on the name of the place of collection.

Observation and Preservation of Algae: The collected samples were brought to the laboratory and temporary slide preparations were made by mounting small part of samples in water. The slides were observed using Labomed Lx 300 Trinocular Research Microscope and photographs were taken using PixelPro Software. Part of collected samples was preserved using a preservative containing Ethanol, Formaldehyde, Glacial Acetic Acid, Glycerol, Water and Copper Sulfate.

Identification of species of *Oedogonium*: The dimensions of the algal cells in the filaments were recorded using Pixel Pro Software. The algae were identified using various monographs and research papers.

The collection was done in the northern part of Raigad District. The sites where *Oedogonium* Link ex Hirn was found to occur are marked in Figure 1.

RESULTS

Genus *Oedogonium* Link ex Hirn 1900

Filaments unbranched, composed of cylindrical or capitellate cells. Filaments attached when young (may become free-floating later). Cells enlarged at the anterior end where usually one or two ring-like scars resulting from cell division may be observed. Basal cell usually modified to form hold-fast cell; apical cell usually broadly rounded or acuminate. Chloroplasts parietal and net-like, usually with several pyrenoids. Reproduction both sexual and asexual. Sexual reproduction oogamous. Suffultory cell sometimes inflated. A species may be monoecious or dioecious; macrandrous or nannandrous. Oogonia one to several in each filament; oogonial opening either by a pore or operculum; oospores may be smooth or variously ornamented.

Type species: *Oedogonium grande* Kützing ex Hirn 1900

Key to species

1. Vegetative cells undulate ..... ***Oedogonium transeaui***
1. Vegetative cells not undulate 2
2. Vegetative cells distinctly capitellate ..... ***Oedogonium virceburgense***
2. Vegetative cells cylindric or slightly capitellate 3
3. Monoecious 4
3. Dioecious (or reproductive structures imperfectly known) 8
4. Oogonium opening by operculum ..... ***Oedogonium loricatum***
4. Oogonium opening by pore 5
5. Vegetative cells 10 – 11 µm wide ..... ***Oedogonium crispum*** var. pithophorae
5. Vegetative cells 19 – 26 µm wide 6
6. Oogonium 34 – 36 µm wide ..... ***Oedogonium brevicingulatum***
6. Oogonium more than 40 µm wide 7
7. Oogonium 39 – 54 X 32 – 51 µm; Oospore globose to subglobose ..... ***Oedogonium vaucherii***
7. Oogonium 40 – 44 X 44 – 51 ..... ***Oedogonium richterianum***
8. Oospore wall with longitudinal ribs ..... ***Oedogonium boscii*** var. notabile
8. Oospore wall scrobiculate ..... ***Oedogonium discretum*** var. calliandrum
8. Oospore wall smooth 9
9. Oogonium opening by pore 10
9. Oogonium opening by operculum 12
10. Pore supramedian ..... ***Oedogonium cardiacum***
10. Pore superior 11
11. Vegetative cells 25 – 26 µm broad ..... ***Oedogonium plagiostomum***
11. Vegetative cells 42 – 57 µm broad ..... ***Oedogonium crassum*** var. subtumidum
12. Operculum superior ..... ***Oedogonium nanum***
12. Operculum median 13
13. Oospore with a median constriction ..... ***Oedogonium pusillum*** var. minus
13. Oospore without median constriction 14
14.Vegetative cells 4 – 6 X 11 – 17 µm; Oogonium single ..... ***Oedogonium inconspicuum***
14.Vegetative cells 3 – 6 X (7 -) 12 – 15 µm; Oogonia 4 – 10 seriate..... ***Oedogonium tapeinosporum*** f. fowlingense
14.Vegetative cells 2.9 – 3.5 X 17 – 27 µm; Oogonia 1 – 2 seriate ..... ***Oedogonium tapeinosporum***
14.Vegetative cells 6 – 7 X 14 – 17 µm; Oogonia 1 – 5 seriate ..... ***Oedogonium tapeinosporum*** f. indicum

Oedogonium boscii var. notabile Lemmermann ex Hirn 1900

Kh – 13 **PLATE I Fig. 1 (a – c)**

Reference:

Guiry, M.D. & Guiry, G.M. 2015; Tiffany, L. H., 1930, p. 92, Plate XXVI, fig. 229 (as *Oedogonium boscii* (Le Clere) Wittrock var. notabile Lemmermann 1898)

Description:

Dioecious; Macrandrous. Female vegetative cells 17 – 19 X 86 – 105 µm. Oogonium 1, suboblong-obovoid, 35 – 42 X 61 – 80 µm; pore superior. Oospore obovoid ellipsoid-obovoid, not filling the oogonium longitudinally; 29 – 38 X 46 – 61 µm, spore wall of three layers: outer and middle layers with 27 – 35 continuous longitudinal ribs. Male vegetative cells (and antheridia) not observed.

Occurrence:

This alga was found in Khalapur, Dist Raigad, Maharashtra (Kh – 13) along with *Oedogonium inconspicuum*, *Spirogyra* sp. and *Nostoc* sp.

Note:

This alga differs from *Oedogonium boscii* var. notabile Lemmermann ex Hirn in having smaller oogonia and oospores.

Distribution in India:

This is probably the first record of the variety from India

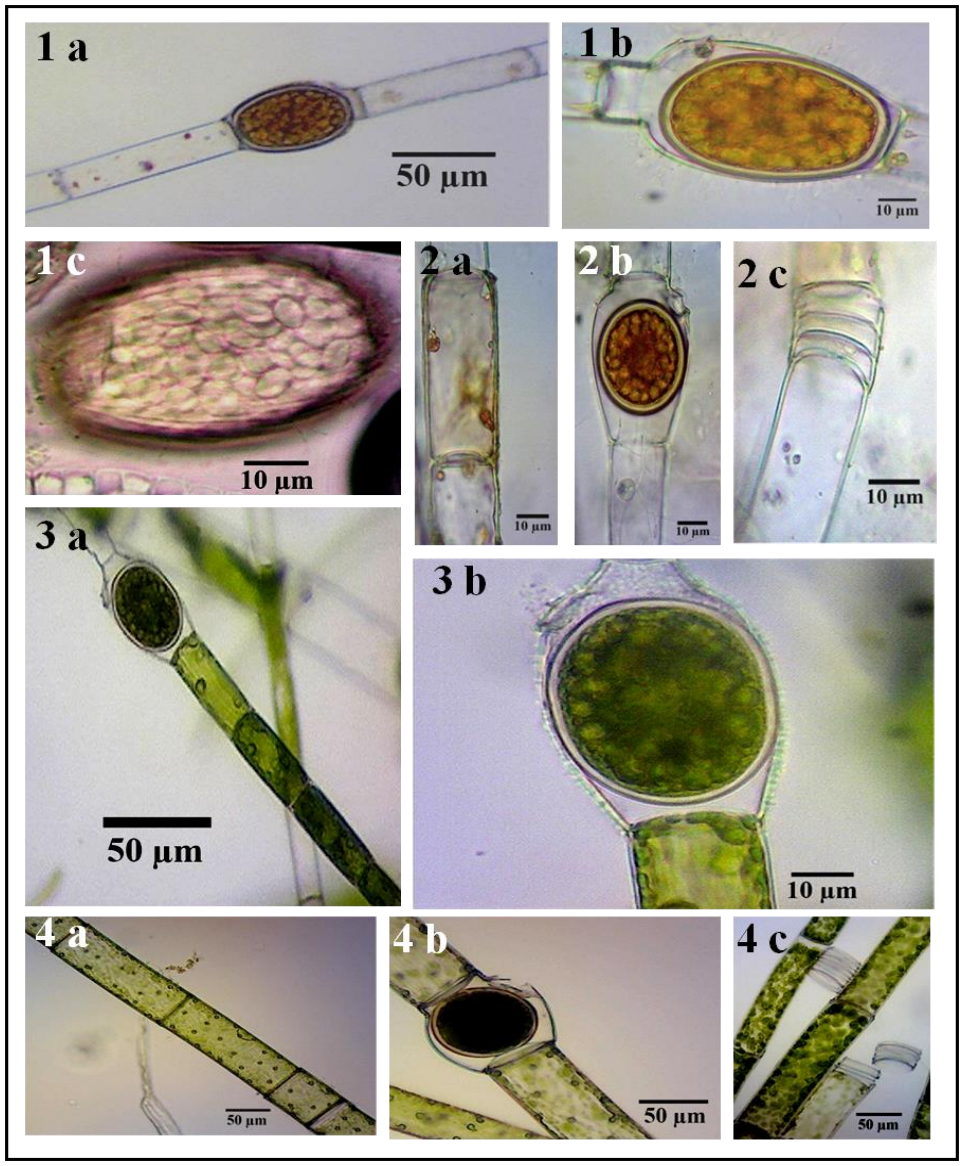

PLATE I: ***Oedogonium*** **Link ex Hirn**

Fig. 1: ***Oedogonium boscii*** **var. notabile Lemmermann ex Hirn** [Fig. 1 a - Filament with oogonium and oospore; Fig. 1 b – An oogonium with oospore and superior pore; Fig. 1 c – Oospore with longitudinal ribs]; **Fig. 2:** ***Oedogonium brevicingulatum*** **Jao** [Fig. 2 a – Vegetative filament; Fig, 2 b – Filament with oogonium and oospore; Fig. 2 c – Filament with antheridia]; **Fig. 3:** ***Oedogonium cardiacum*** **var. minus Lemmermann** [Fig.3 a – A filament with oogonium and oospore; Fig. 3 b – An oogonium with oospore]; **Fig. 4:** ***Oedogonium crassum*** **var. subtumidum Hirn** [Fig. 4 a – A vegetative filament; Fig. 4 b – An oogonium with oospore; Fig, 4 c – Vegetative filaments and antheridia]

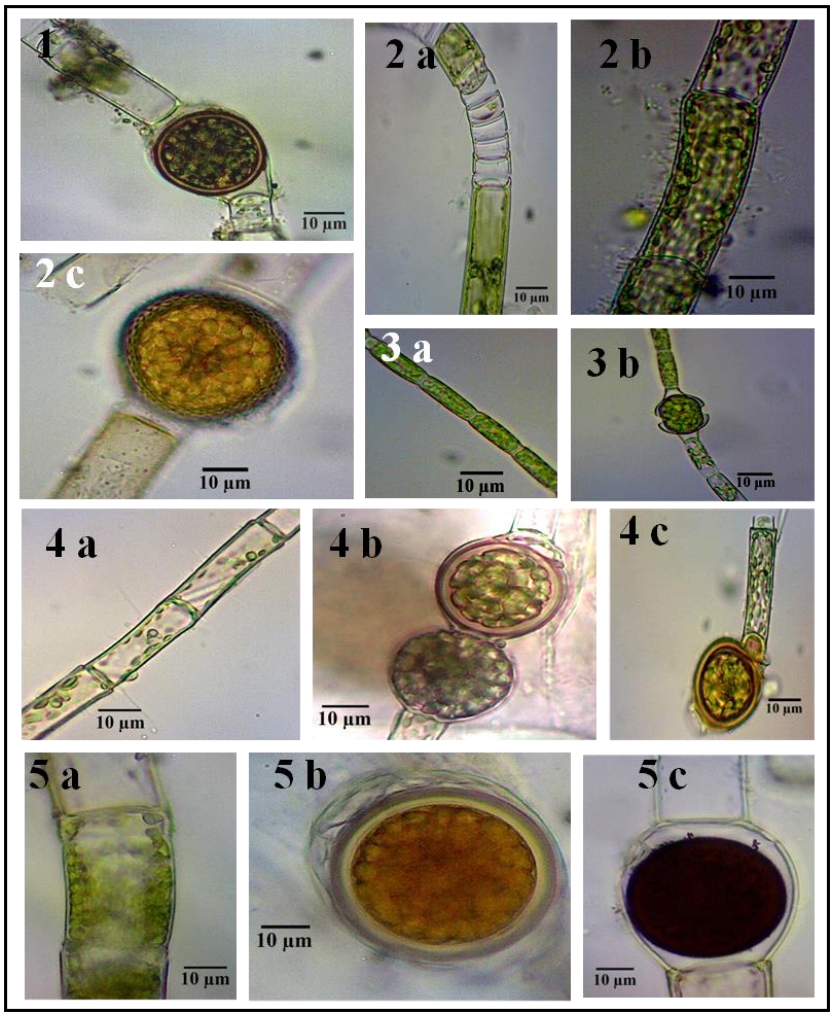

PLATE II: *Oedogonium* Link ex Hirn

Fig. 1: *Oedogonium crispum* var. pithophorae (Wittrock ex Hirn) Islam & Sarma [A filament with oogonium bearing oospore]; **Fig. 2: *Oedogonium discretum* var. calliandrum (L. R. Hoffman) Mrozinska** [Fig. 2 a – Filament with antheridia; Fig. 2 b – A vegetative filament; Fig. 2 c – Filament with oogonium bearing oospore with scrobiculate wall]; **Fig. 3: *Oedogonium inconspicuum* Hirn** [Fig. 3 a – A vegetative filament; Fig. 3 b – A filament with oogonium and oospore. The opening in the oospore is by the median operculum]; **Fig. 4: *Oedogonium loricatum* Hirn ex Hirn** [Fig. 4 a – A vegetative filament; Fig. 4 b – Oogonia and oospores; Fig.4 c – a filament with oogonium, oospore and antheridium]; **Fig. 5: *Oedogonium plagiostomum* Wittrock ex Hirn** [Fig. 5 a – A vegetative filament; Fig. 5 b – An oospore with thick wall; Fig. 5 c – An oogonium with a superior wall bearing a fully mature spore]

Oedogonium brevicingulatum Jao 1935
Shelu (03) – 11 **PLATE I Fig. 2 (a – c)**

References:
Gonzalves, E. A., 1981, p. 159, Fig. 9.22 A; Jao, C. C., 1935, p. 57, Plate X, Figs. 1 – 3.

Description:
Macrandrous; Monoecious. Vegetative cells cylindric, 19 – 24 X 63 – 71 µm. Basal and Terminal cells mot observed. Oogonium single, a little inflated, obovoid-globose to obovoid, poriferous, 34 – 36 X 52 – 61 µm; pore superior. Oospore almost globose, not filling the oogonium longitudinally, 29 – 34 X 38 – 42 µm; spore wall smooth, often thick. Antheridia 2 – 3 seriate, subepigynous, subhypogynous or scattered, mostly alternating with a vegetative cell; 17 – 18 X 4 – 6 µm. Spermatozoids not observed.

Occurrence:
The alga was found in Shelu, Dist. Raigad, Maharashtra [Shelu (03) – 01] along with *Oedogonium plagiostomum, Zygnema frigidum* and *Nostoc* sp.

Note:
The alga differs in having slightly narrower vegetative cells, oogonia, oospores and antheridia than described for the species. Also, the oogonia are longer than described for the species.

Distribution in India:
Maharashtra (Gonzalves, E. A., 1981)

Oedogonium cardiacum var. minus Lemmermann 1909
NGTN – 02 **PLATE I Fig. 3 (a, b)**

Reference:
Tiffany, L. H., 1930, p. 71, Plate XIII, fig. 129.

Description:
Dioecious; Macrandrous. Female vegetative cells: 13 – 20 X 37 – 55 µm. Oogonium 1, sub-globose to sub-cordiform-globose, 29 – 38 X 44 – 59 µm; with a supramedian pore. Oospore globose, not filling the oogonium, 28 – 37 X 29 – 46 µm; spore wall smooth. Male filaments and antheridia not observed in our collection.

Occurrence:
The alga was found in Nagothane, Dist. Raigad, Maharashtra (NGTN – 02).

Note:
This alga differs from *Oedogonium cardiacum* var. minus in having some vegetative cells and oogonia that are slightly narrower and some oogonia and oospores that are longer than those described for the species.

Distribution in India:
Maharashtra (Gonzalves, E. A., 1981)

Oedogonium crassum var. subtumidum Hirn 1900
Maldunge (02) – 04 **PLATE I Fig. 4 (a – c)**

References:
Gonzalves, E. A., 1981, p. 264, Fig. 9.142 A.; Tiffany, L. H., 1930, p. 88 - 89, Plate XXIII, fig. 206, 207.

Description:
Dioecious; Macrandrous. Female vegetative cells: 42 – 57 X 138 – 214 µm; Male vegetative cells: 49 – 53 X 147 – 152 µm. Oogonium 1, ovoid to obovoid-ellipsoid, 65 – 87 X 73 – 94 µm; pore superior. Oospore ellipsoid to globose, filling or not filling oogonium, 57 – 71 X 58 – 78 µm; spore wall smooth. Antheridia 7 – 8; 41 – 48 X 5 – 9 µm. Sperms not observed.

Occurrence:
This alga was found in Maldunge, Dist. Raigad, Maharashtra [Maldunge (02) – 04] along with *Pithophora oedogonia* var. calcarata, *Spirogyra* sp. and other species of *Oedogonium*.

Note:
This alga differs in having some female vegetative cells that are narrower and some male vegetative cells that are broader than described for the species. Some oogonia, oospores and antheridia are broader and some oogonia are narrower than described for the type. Also, some oospores and antheridia are shorter.

Distribution in India:
Andhra Pradesh (Gonzalves, E. A., 1981)

Oedogonium crispum var. pithophorae (Wittrock ex Hirn) Islam & Sarma 1976
Basionym: *Oedogonium pithophorae* Wittrock ex Hirn
Homotypic Synonym: *Oedogonium pithophorae* Wittrock ex Hirn 1900
Kh – 15

PLATE II **Fig. 1**

References:
Guiry, M.D. & Guiry, G.M., 2015; Tiffany, L. H., 1930, p. 112, Plate XXXVI, fig. 338 (as *Oedogonium pithophorae* Wittrock 1878)

Description:
Monoecious; Macrandrous. Vegetative cells: 10 – 11 X 32 – 33 µm. Oogonium 1, pyriform-globose, 25 – 26 X 30 – 31 µm; operculate, division superior. Oospore globose, almost filling oogonium, 24 – 25 X 24 – 25 µm; spore wall smooth. Antheridia 2 – 3; 9 – 11 X 3 – 5 µm. Basal cell not observed.

Occurrence:
This alga was found in Khalapur, Dist. Raigad, Maharashtra (Kh – 15) along with *Sirocladium maharashtrense* and *Cosmarium* sp.

Note:
This alga differs in having slightly narrower oogonia and oospores. The antheridia are slightly broader and shorter than described for the species.

Distribution in India:
Karnataka (Gonzalves, E. A., 1981); West Bengal (Kargupta, A. N. and Keshri, J. P., 2006).

Oedogonium discretum var. calliandrum (L. R. Hoffman) Mrozinska 1985
Basionym: *Oedogonium calliandrum* L. R. Hoffman
Homotypic Synonym: *Oedogonium calliandrum* L. R. Hoffman 1967
KD – 02

PLATE II **Fig. 2 (a – c)**

Reference:
Guiry, M.D. & Guiry, G.M. 2015; Gonzalves, E. A., 1981, p. 565 - 566, Fig. 9.510 (as *Oedogonium calliandrum* L. R. Hoffman 1967)

Description:
Dioecious; Macrandrous. Vegetative cells cylindric; 14 – 19 µm in diameter, 38 – 64 µm long, those of the female cells of the same size or slightly broader and shorter. Basal and Terminal cells not observed. Oogonia 1 - 2, globose, subglobose or obovoid-globose, sometimes depressed globose, opening by a superior pore; 33 – 42 µm in diameter and 27 – 49 µm long. Oospore globose or subglobose, filling or rarely not filling the oogonium, outer layer of spore wall scrobiculate; 31 – 38 µm in diameter, 24 – 40 µm long. Antheridia up to 6 seriate; 11 – 16 µm in diameter and 5 – 7 µm long, usually alternating with a vegetative cell, spermatozoids 2, division horizontal.

Occurrence:
This alga was found growing in a roadside puddle of water in Khandeshwar, Navi Mumbai, Dist. Raigad, Maharashtra (KD – 02) along with *Uronema confervicolum*, *Spirogyra* sp. and other species of *Oedogonium*.

Note:
This alga differs in having some oospores and oogonia that are somewhat shorter than described for the species. Also, some oogonia are longer and some antheridia are narrower than described for the species.

Distribution in India:
Jharkhand (Das Guru, S., Kumari, S. and Verma, K., 2013).

Oedogonium inconspicuum Hirn 1895
Kh – 13

PLATE II **Fig. 3 (a, b)**

Reference:
Prescott, G. W., 1970, p. 183 - 184, Plate 37, fig. 1, 2.; Tiffany, L. H., 1930, p. 160, Plate XXXIV, fig. 312, 313.

Description:
Dioecious; Macrandrous. Female vegetative cells 4 – 6 X 11 – 17 µm. Oogonium 1, depressed or subpyriform-globose, 13 – 16 X 16 – 19 µm; operculate, division median. Oospore depressed globose, filling the inflated part of the oogonium, 10 – 12 X 12 – 15 µm; spore wall smooth. Antheridia not observed.

Occurrence:
The alga was found in Khalapur, Dist. Raigad, Maharashtra (Kh – 13), along with *Oedogonium boscii* var. notabile, *Spirogyra* sp. and *Nostoc* sp.

Note:
This alga differs in having vegetative cells that are shorter and some that are slightly broader than those of the species. Also, the oospores are slightly narrower and longer than those of the species.

Distribution in India:
Maharashtra, Karnataka (Gonzalves, E. A., 1981); Kerala (Paul, T. P., 2012).

Oedogonium loricatum Hirn ex Hirn 1900
KRRC – 06

PLATE II **Fig. 4 (a – c)**

Reference:
Guiry, M.D. & Guiry, G.M. 2015; Gonzalves, E. A., 1981, p. 216 - 217, Fig. 9. 88 A (as *Oedogonium loricatum* Hirn 1895); Tiffany, L. H., 1930, p. 111, Plate XXXVI, fig. 339. (as *Oedogonium loricatum* Hirn 1895)

Description:
Monoecious. Vegetative cells 8 – 11 X 21 – 34 µm. Oogonium 1 – 2, subpyriform-globose, sometimes subglobose, 25 – 29 X 23 – 27 µm; operculate, division superior. Oospore subglobose or sub-depressed-globose, quite filling oogonium, 23 – 27 X 19 – 23 µm; spore wall smooth. Antheridium 1, subepigynous, 6 – 9 X 3 – 4 µm; sperms not observed.

Occurrence:
This alga was found in Karjat Rice Research Centre, Karjat, Dist. Raigad, Maharashtra (KRRC – 06) along with *Oedogonium vaucherii*, *Oedogonium virceburgense*, *Sirogonium tenuius* and *Spirogyra biformis*.

Note:
The alga differs in having some vegetative cells, oospores and antheridia that are shorter than the type. Some oogonia, oospores and antheridia are slightly

broader than described for the species. Also, some antheridia are slightly narrower.

Distribution in India:
Maharashtra (Gonzalves, E. A., 1981)

Oedogonium nanum Wittrock ex Hirn 1900
Chipale – 01 **PLATE III Fig. 1 (a – d)**

References:
Guiry, M.D. & Guiry, G.M. 2015; Gonzalves, E. A., 1981, p. 341 - 342, Fig. 9. 226 (*Oedogonium nanum* Wittrock 1874); Prescott, G. W., 1970, p. 185, Plate 36, Figs. 10 (*Oedogonium nanum* Wittrock 1874); Tiffany, L. H., 1930, p. 109, Plate XXXVI, fig. 342, 343. (Oedogonium nanum Wittrock 1874)

Description:
Dioecious; Macrandrous. Vegetative cells often irregularly swollen, 5 – 8 X 22 – 34 µm. Basal cell sub-hemispherical, 16 – 17 X 8 – 9 µm. Terminal cell often an oogonium, apically obtuse. Oogonium 1, ovoid to broadly ellipsoid, 17 – 24 X 19 – 31 µm; operculate, division superior. Oospore ovoid to globose ellipsoid, usually filling the oogonium, 16 – 23 X 14 – 27 µm; spore wall smooth. Antheridia not observed.

Occurrence:
This alga was found growing on Pithophora polymorpha in Chipale, Dist. Raigad, Maharashtra (Chipale – 01) along with *Hydrodictyon* sp. and *Anabaena* sp.

Note:
The alga differs in having some vegetative cells, oogonia and oospores that are narrower than described for the species. Also, some oogonia, oospores and the basal cell are shorter than described for the species.

Distribution in India:
Maharashtra, Himachal Pradesh, Pondicherry (Gonzalves, E. A., 1981)

Oedogonium plagiostomum Wittrock ex Hirn 1900
Shelu (03) – 11

PLATE II **Fig. 5 (a – c)**

References:
Guiry, M.D. & Guiry, G.M. 2015; Gonzalves, E. A., 1981, p. 287, Fig. 9.166 A (as *Oedogonium plagiostomum* Wittrock 1872); Prescott, G. W., 1970, p. 173, Plate 32, fig. 3, 4 (as *Oedogonium plagiostomum* Wittrock 1872); Tiffany, L. H., 1930, p. 80, Plate XIV, fig. 140. (as *Oedogonium plagiostomum* Wittrock 1872)

Description:
Dioecious; Macrandrous. Vegetative cells cylindric, rather stout, 25 – 26 X 32 – 33 µm; Oogonium 1, ovate-globose, 42 – 49 X 40 – 42 µm; opening by a superior pore; Oospores globose to subglobose, 37 – 43 X 32 – 41 µm; wall thick, smooth; Antheridia not found.

Occurrence:
The alga was found growing in Shelu, Dist. Raigad, Maharashtra [Shelu (03) – 11] along with *Zygnema frigidum* and other species of *Oedogonium*.

Note:
The alga differs in having shorter vegetative cells, oogonia and oospores than described for the species.

Distribution in India:
Assam, Maharashtra, Uttar Pradesh (Gonzalves, E. A., 1981); Jharkhand (Guru, S. D., Kumari, S. and Verma, K.., 2013).

Oedogonium pusillum var. minus Gonzalves and Sonnad 1961
S (02) – 04 **PLATE III Fig. 2 (a, b)**

References:
Gonzalves, E. A., p. 228 - 229, Fig. 9.102 C.

Description:
Vegetative cells cylindric, 4 – 5 X 11 – 18 µm. Oogonium up to 7 seriate, subconical-ellipsoid to subconical-globose, 10 – 12 X 12 – 16 µm; operculate, division median, broad, oospore subglobose, slightly constricted in the middle, not filling the oogonium, 7 – 10 X 11 – 13 µm; spore wall smooth. Antheridia not observed.

Occurrence:
The alga was found growing in Karjat, Dist. Raigad, Maharashtra [S (02) – 04] along with *Oedogonium tapeinosporum* f. indicum and Spirogyra sp.

Note:
The alga differs in having some zygospores that are narrower than described for the species. Also, oogonia are up to 7 seriate and not 4 seriate as described.

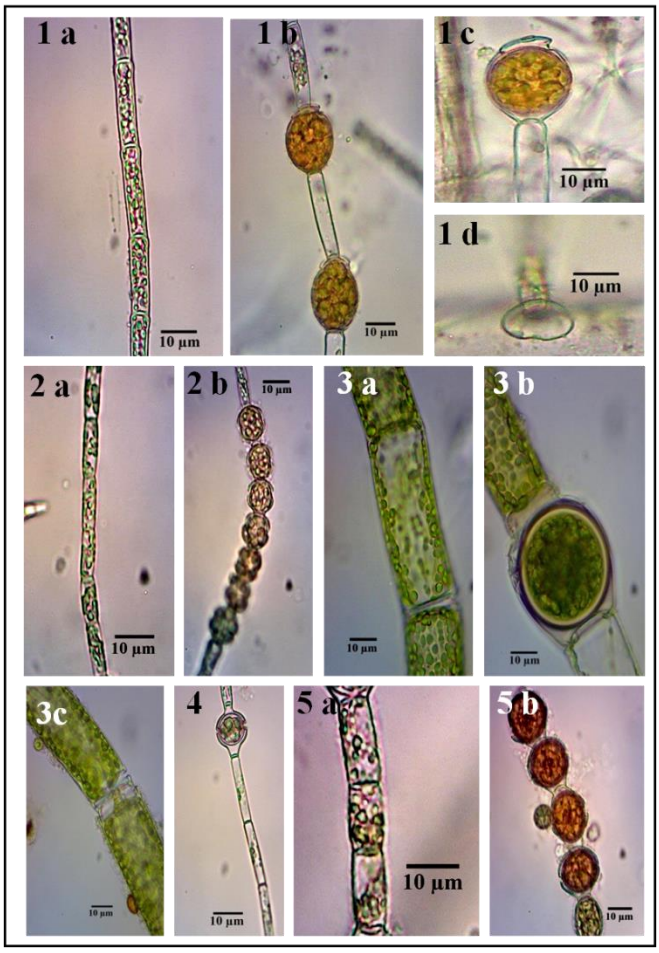

PLATE III: *Oedogonium* Link ex Hirn

Fig. 1: *Oedogonium nanum* Wittrock ex Hirn [Fig. 1 a – A vegetative filament; Fig. 1 b – A filament with oogonia and oospores; Fig. 1 c – Oogonium with oospore and superior operculum; Fig. 1 d – Basal cell]; **Fig. 2: *Oedogonium pusillum* var. minus Gonzalves and Sonnad** [Fig. 2 a – A vegetative filament; Fig. 2 b – Oogonia (in series) bearing oospores]; **Fig. 3: *Oedogonium richterianum* Lemmermann ex Hirn** [Fig. 3 a – A vegetative filament; Fig. 3 b – Filament with oogonia and oospore; Fig. 3 c – filament with antheridia]; **Fig. 4: *Oedogonium tapeinosporum* Wittrock ex Hirn** [A filament with oogonium bearing oospore , oogonial opening by a median or supramedian operculum]; **Fig. 5: *Oedogonium tapeinosporum* f. indicum Gonzalves and Jain** [Fig. 5 a – A vegetative filament; Fig. 5 b – Oogonia (in series) bearing oospores]

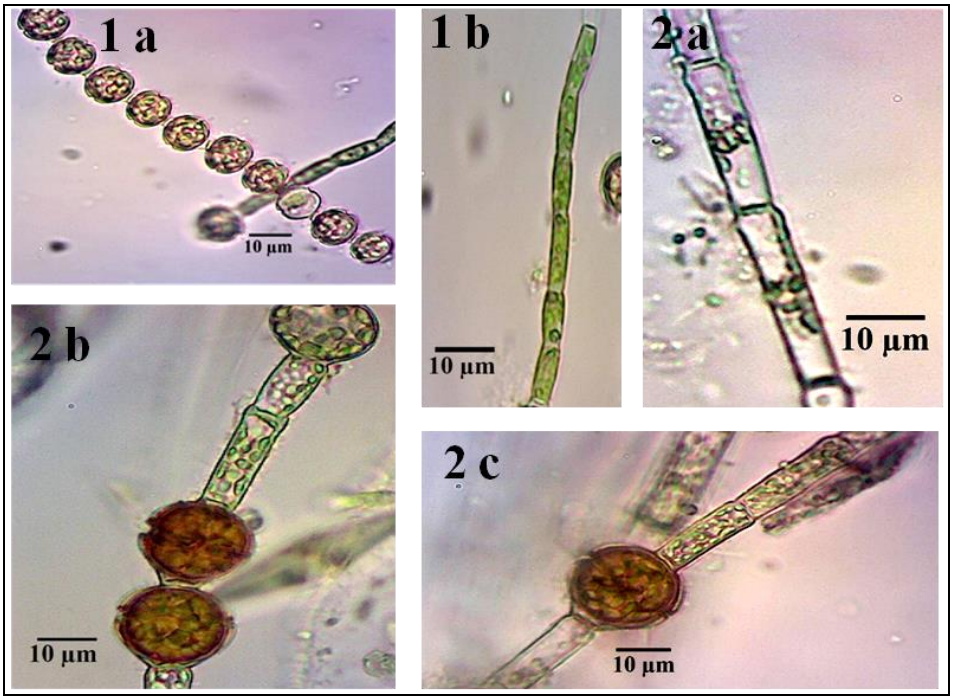

PLATE IV: *Oedogonium* Link ex Hirn

Fig. 1: *Oedogonium tapeinosporum* f. fowlingense Jao [Fig. 1 a – Oogonia (in series) with oospores; Fig 1 b – A vegetative filament]; **Fig. 2: *Oedogonium virceburgense* Hirn ex Hirn** [Fig. 2 a – A vegetative filament; Fig. 2 (b, c) – Filament with oogonia and oospores]

Distribution in India:
Karnataka (Gonzalves, E. A., 1981)

Oedogonium richterianum Lemmermann ex Hirn 1900 Kh – 20 **PLATE III Fig. 3 (a – c)**

References:
Guiry, M.D. & Guiry, G.M. 2015; Prescott, G. W., 1970, p. 180 - 181, Plate 43, fig. 8 (as *Oedogonium richterianum* Lemmermann 1895); Tiffany, L. H., 1930, p. 76, Plate XVI, fig. 156 (as *Oedogonium richterianum* Lemmermann 1895)

Description:
Monoecious; Macrandrous. Vegetative cells 22 – 25 X 68 – 78 µm. Oogonium 1, obovoid or subellipsoid, 40 – 44 X 44 – 51 µm; pore superior. Oospore subobovoid or subellipsoid, filling oogonium or not, 38 – 42 X 44 – 51 µm; spore wall smooth. Antheridia 2 – 3, subhypogynous or subepigynous or scattered, 21 – 24 X (3 -) 6 – 7 µm.

Occurrence:
This alga was found in Khalapur, Dist. Raigad, Maharashtra (Kh – 20) along with *Spirogyra* sp. and other species of *Oedogonium*.

Note:
The alga differs in having broader vegetative cells and antheridia than described for the species. Also, some antheridia are shorter than those of the species.

Distribution in India:
Maharashtra, Karnataka (Gonzalves, E. A., 1981)

Oedogonium tapeinosporum Wittrock ex Hirn 1900 Bhanavle River – 02 **PLATE III Fig. 4**

References:
Guiry, M.D. & Guiry, G.M. 2015; Gonzalves, E. A., 1981, p. 550 - 551, Fig. 9.482 A (*Oedogonium tapeinosporum* Wittrock 1874); John, D. M., Whitton, B. A., Brook, A. J., 2011, p. 521, Plate 126 M (*Oedogonium tapeinosporum* Wittrock 1874); Prescott, G. W., 1970, p. 188, Plate 38, fig. 11, 12 (*Oedogonium tapeinosporum* Wittrock 1874); Rai, S. K., 2012, p. 22, Plate 6 (*Oedogonium tapeinosporum* Wittrock 1874); Tiffany, L. H., 1930, p. 159 - 160, Plate XXXIV, fig. 314 (*Oedogonium tapeinosporum* Wittrock 1874)

Description:
Vegetative cells: 2.9 – 3.5 X 17 – 27 µm. Oogonium 1 – 2 (- 4), depressed-globose, 10 – 16 X 11 – 19 µm; operculate, division median, distinct. Oospore depressed-globose, not (rarely nearly) filling oogonium, 8 – 13 X 9 – 14 µm; spore wall smooth. Basal cell not observed. Terminal cell not observed. Antheridia not observed.

Occurrence:
The alga was found growing along with *Cosmarium* sp., *Staurastrum* sp., *Bulbochaete* sp., *Spirogyra* sp. and other species of *Oedogonium* in Bhanavle River, Karjat, Dist. Raigad, Maharashtra (Bhanavle River – 02).

Note:
The alga differs in having some oogonia and some oospores that are narrower than described for the species. Some oogonia are shorter than described for the species.

Distribution in India:
Andhra Pradesh, Assam, Maharashtra, Karnataka (Gonzalves, E. A., 1981); Himachal Pradesh (Kumar, R., Seth, M. K., Suseela, M. R., 2012).

Oedogonium tapeinosporum f. fowlingense Jao 1937 Lowjee – 04, S (02) – 02

PLATE IV **Fig. 1 (a, b)**

References:
Gonzalves, E. A., 1981, p. 552, Fig. 9.482 B; Jao, C. C., 1937, pp. 299 – 313, p. 307 – 308, Plate III, Figs. 25 – 28; Venkataraman, G. S. and Natarajan, K. V., 1959, p. 17, Fig. 23.

Description:
Vegetative cells cylindric, 3 – 6 X (7 -) 12 – 15 µm. Basal cell not observed. Suffultory cell sometimes inflated. Terminal cell obtuse. Oogonia (1-) 4 to 10 – seriate, pyriform to pyriform-globose, 8 – 16 X 10 – 17 µm; operculate, division median or supramedian, distinct. Oospore depressed-globose, very rarely globose, not filling the oogonium longitudinally, 7 – 11 X (8-) 14 – 15 µm.

Occurrence:
The alga was found in Lowjee, Dist. Raigad, Maharashtra (Lowjee – 04) along with *Spirogyra minor*, *Oscillatoria* sp. and *Nostoc* sp. The alga was also found growing in Karjat, Dist. Raigad, Maharashtra [S (02) – 02] along with *Spirogyra hyalina* and *Scenedesmus* sp.

Note:
The alga differs in having some vegetative cells, oogonia and oospores that are shorter than described for the species. Also, some oogonia and oospores are narrower.

Distribution in India:
Kerala, Uttar Pradesh (Gonzalves, E. A., 1981); West Bengal (Kargupta, A. N. and Keshri, J. P., 2006).

Oedogonium tapeinosporum f. indicum Gonzalves and Jain 1970
S (02) – 04 **PLATE III Fig. 5 (a, b)**

Reference:
Gonzalves, E. A., 1981, p. 553, Fig. 9.482 D.

Description:
Vegetative cells cylindric, 6 – 7 X 14 – 17 µm. Basal and terminal cells not observed. Oogonia 1 – 5 seriate, pyriform-globose, 16 – 24 X 17 – 26 µm; operculate, division median. Oospore pyriform-globose or obovoid-globose, not filling the oogonium longitudinally, 15 – 21 X 14 – 22 µm; spore wall smooth. Antheridia not observed.

Occurrence:
The alga was found in Karjat, Dist. Raigad, Maharashtra [S (02) – 04] along with *Oedogonium pusillum* var. minus and *Spirogyra* sp.

Note:
The alga differs in having some vegetative cells, some oogonia and oospores that are broader and some that longer than described for the species. Also, oogonia are 1 – 5 seriate and not 4 – 10 seriate as described.

Distribution in India:
Maharashtra (Gonzalves, E. A., 1981).

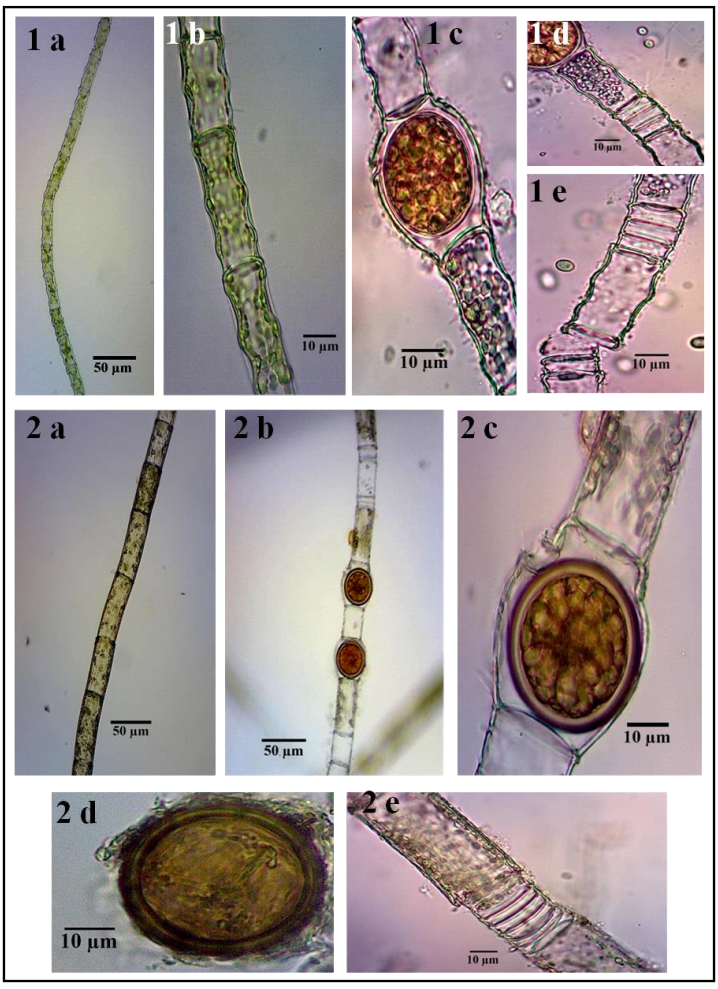

PLATE V: *Oedogonium* Link ex Hirn
Fig. 1: *Oedogonium transeaui* Gonzalves and Jain [Fig. 1 (a, b) – Vegetative filament with cells having undulate walls; Fig. 1 c - Filament with oogonium bearing oospore and superior to supramedian pore; Fig. 2 d – Filament with antheridia]; **Fig. 2: *Oedogonium vaucherii* A. Braun ex Hirn** [Fig. 2 a – A vegetative filament; Fig 2 b – filament with oogonia and oospores; Fig. 2 c – Oogonium bearing oospore and superior pore; Fig. 2 d – Oospore with smooth wall; Fig. 2 e – Filament with antheridia]

Oedogonium transeaui Gonzalves and Jain 1968
Kel (03) – 05

PLATE V **Fig. 1 (a – e)**

Reference:
Gonzalves, E. A., 1981, p. 561, Fig. 9.502.

Description:
Monoecious; Macrandrous. Vegetative cells undulate, 14 – 18 X 28 – 47 µm. Basal and terminal cells not observed. Oogonium single, ovoid to ovoid globose, rarely depressed globose, 26 – 36 X 27 – 37 µm; pore supramedian to superior. Oospore globose to subglobose, sometimes not filling the oogonium, 22 – 34 X 26 – 33 µm; spore wall smooth. Antheridium single or up to 3 – seriate, subepigynous, subhypogynous or scattered, 13 – 17 X 4 – 7 µm.

Occurrence:
The alga was found in Kelavali, Dist. Raigad, Maharashtra [Kel (03) – 05] along with *Spirogyra* sp., *Cosmarium* sp., *Zygnema* sp. and other species of *Oedogonium*.

Note:
The alga differs in having some vegetative cells, oogonia, oospores and antheridia that are shorter than described for the species. Some oogonia and oospores are slightly narrower. Some oospores and antheridia are broader while some oospores are longer than described for the species.

Distribution in India:
Maharashtra (Gonzalves, E. A., 1981)

Oedogonium vaucherii A. Braun ex Hirn 1900
Basionym: *Prolifera vaucheri* Le Clerc
Homotypic Synonym: *Prolifera vaucheri* Le Clerc 1817
Heterotypic Synonyms*: Oedogonium monandronites* H. J. Carter, *Oedogonium diandronites* H. J. Carter 1858, *Oedogonium vaucheri* var. parvum Gonzalves & Sonnad 1961
Lowjee – 02, Bhanavle River – 01, KRRC – 06

PLATE V **Fig. 2 (a – e)**

Reference:
Guiry, M.D. & Guiry, G.M. 2015; Gonzalves, E. A., 1981, p. 187 - 188, Fig. 9.56 A (as *Oedogonium vaucherii* (Le Clere) A. Braun 1855); John, D. M., Whitton, B. A., Brook, A. J., 2011, p. 524, Plate 125 H (as *Oedogonium vaucherii* (Le Clere) A. Braun 1855); Prescott, G. W., 1970, p. 182, Plate 43, fig. 20. (as *Oedogonium vaucherii* (Le Clere) A. Braun 1855); Tiffany, L. H., 1930, p. 76, Plate XV, fig. 150, 151. (as *Oedogonium vaucherii* (Le Clere) A. Braun 1855)

Description:
Monoecious; Macrandrous. Vegetative cells: 21 – 27 X 41 – 92 µm. Oogonium 1, obovoid to subovoid – globose, 39 – 54 X 32 – 51 µm; pore superior. Oospore globose to subglobose, filling or not filling oogonium, 34 – 48 X (26 -) 35 – 45 µm; spore wall smooth; antheridium 1 – 3; 19 – 27 X (3.5 -) 6 – 7 µm.

Occurrence:
The alga was found in Bhanavle River, Karjat Rice Research Centre (near Karjat) and Lowjee, Dist. Raigad, Maharashtra (Bhanavle River – 01, KRRC – 06 and Lowjee – 02).

Note:
The alga differs from *Oedogonium vaucherii* (Le Cl.) A. Braun in having some oogonia and oospores that are slightly narrower than those of the type (Lowjee – 02, Bhanavle River – 01, KRRC – 06). The oogonia and oospores are somewhat shorter than described for the species (Bhanavle River – 01, KRRC - 06) Also, the antheridia are shorter than those described for the type (Lowjee – 02, KRRC – 06).

Distribution in India:
Andhra Pradesh, Gujarat, Maharashtra, Karnataka (Gonzalves, E. A., 1981); West Bengal (Kargupta, A. N. and Keshri, J. P., 2006).

Oedogonium virceburgense Hirn ex Hirn 1900
KRRC – 06, Dol (02) – 04

PLATE IV **Fig. 2 (a – c)**

References:
Guiry, MD & Guiry GM (2015); Gonzalves, E. A., 1981, p. 525 - 526, Fig. 9.433 A (as *Oedogonium virceburgense* Hirn 1896); Tiffany, L. H., 1930, p. 164, Plate XXXVI, fig. 33 (as *Oedogonium virceburgense* Hirn 1896)

Description:
Vegetative cells often broadly capitellate, 5 – 8 X 17 – 25 µm. Basal cell not observed. Oogonium 1 – 5, subpyriform to subdepressed-globose, 15 – 21 X 14 –

22 µm; operculate, division a little above median. Oospore subdepressed or depressed globose, quite filling oogonium, 13 – 19 X 12 – 20 µm; spore wall smooth.

Occurrence:

The alga was found in Dolavali and Karjat Rice Research Centre, Karjat, Dist. Raigad, Maharashtra [Dol (02) – 04 and KRRC – 06].

Note:

The alga differs in having some vegetative cells that are broader than described for the species. The alga from Karjat differs in having some oogonia that are slightly broader and some that are slightly shorter than the type. Also, some oospores are shorter and some are longer than described for the species. The alga from Dolavali differs in having some oogonia that are narrower than described for the species.

Distribution in India:

Maharashtra, Karnataka (Gonzalves, E. A., 1981).

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