OEDOGONIUM IN PESHAWAR VALLEY

By

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Abstract

Twenty two taxa of Oedogonium have been described from Peshawar Valley of N.W.F.P., Pakistan. A new species, O. ahmadii, and a subspecies, O. crassiusculum subsp. peshawarensis, have also been described. All these taxa are new records from Pakistan.

Introduction

The fresh-water algal flora of Pakistan is being worked out extensively in the Department of Botany, University of Peshawar and this study is a part of the programme.

The taxa collected are as under:


Out of these taxa a species viz: O. ahmadii and one new subspecies, O. crassiusculum ssp. peshawarensis are new while the description of an incomplete species O. pusillum has been completed.

Material and Methods

The collection of Oedogonium was made from the semi-permanent and permanent ponds, pools of rain water and springs by hand picking, plankton-net, squeezing and scraping the aquatic vegetation.

The specimens were examined in fresh condition and were preserved in 3% formalin. Immature specimens were cultured in soil extract (Faridi 1964, 1971). To clear the specimens 2% potassium hydroxide or 5% acetic acid solutions were used. The drawings were made by Camera Lucida. The numbers of the specimens are those of Shahid Farooq. All the specimens have been deposited in the Department of Botany, University of Peshawar.

Ecology

The genus Oedogonium is fairly common in Peshawar Valley and found in almost all types of waters. They are common in turbid ponds, permanent ponds, ditches, puddles, semi-permanent ponds and rarely in springs. The species of the genus are mostly attached to water weeds and sticks. They are also found rarely floating.
The sexual reproduction of *Oedogonium* in Peshawar Valley mostly takes place in late Winter and early Spring unlike the U.S.A. The small-sized species have generally shorter vegetative period and mature earlier than the large-sized ones as also reported by Tiffany (1930).

It was reported (Islam and S. rma, 1964), that *Lemma* does not encourage the growth of *Oedogonium*. This statement does not seem to be universal as *O. crassiusculum* ssp. *peshawarense* was collected from a pond where *Lemma* was dominant. It is true that other taxa of *Oedogonium* were not collected from such localities where *Lemma* is dominant, but it is probably not due to any antagonism between the two. Aquatic angiosperms curtail light to a minimum and the growth of *Oedogonium* probably suffers because of the lack of light.

Since this study is based on collection made in Winter, Spring and early Summer only, no conclusion can be drawn about the periodicity of the species in Peshawar Valley for the whole year.

The soil of Peshawar Valley is basic with a pH ranging from 7.00 to 9, rarely up to 9.6 with an annual average rainfall of 13.6 inches. The total area of the Valley is 6,053 sq. miles and is surrounded by high mountains. The Valley is rich in springs.

**Taxonomy**

Filaments single, unbranched: vegetative cells uninucleate, cylindrical, or capitellate, nodulose or undulate; chlorenchyma reticulate, with numerous pyrenoids at intersections of reticulum; basal cell with hold fast; apical cell obtuse, apiculate or hyaline; vegetative cells, except the basal one, capable of division; oogonia and antheridia produced by direct division of vegetative cells; zoospores multiformellate.

**KEY TO THE SPECIES**

1. Cells undulate ........................................ *O. undulatum*  
1. Cells distinctly capitellate .............................. 2  
1. Cells cylindrical ........................................ 5  
2. Without dwarf male ........................................ *O. nitratum*  
2. With dwarf male ............................................. 3  
3. Oogonium 28-35 µm wide ..................................... *O. decipiens*  
3. Oogonium 35-66 µm wide ..................................... 4  
4. Oospore not filling oogonium ............................. *O. ahmadii*  
4. Oospore filling oogonium .................................. *O. hirnii* subsp. *africanum*  
5. Without dwarf male ........................................... 6  
5. With dwarf male ............................................. 15  
6. Oogonium opening by a lid .................................. *O. pusillum*  
6. Oogonium opening by pore .................................. 7  
7. Pore median ............................................... 8  
7. Pore supera median ......................................... 10  
7. Pore superior ............................................. 11  
8. Spore wall scrobiculate .................................... *O. magnusii*  
8. Spore wall smooth ......................................... 9  
9. Monoeious ................................................. *O. cryptorum* subsp. *vulgare*  
9. Dioecious ................................................ *O. rufescens* subsp. *exiguum*  
10. Vegetative cell 8-12 µm thick ....................... *O. franklinianum*  
10. Vegetative cell 12-16 µm thick ....................... *O. varians*
11. Spore wall reticulate ..................  O. dictyosporum
11. Spore wall smooth .................... 12
11. Spore wall scrobiculate ............... 13
  12. Oogonium 28-31 µm thick .........  O. hirnii
  12. Oogonium 60-75 µm thick ........  O. crassum
13. Sulfuricary cells enlarged ..................  O. scrobiculatum
13. Sulfuricary cells not enlarged ........... 14
  14. Oogonium 45-53 µm thick ........  O. argenteium
  14. Oogonium 51-64 µm thick ........  O. wyliei
15. Pore median .................................. 16
15. Pore superior .................................. 18
  16. Spore wall spiny ..................  O. hystrix
  16. Spore wall smooth .................. 17
  17. Vegetative cell 9-12 µm thick ..........  O. seminapertum
  17. Vegetative cell 12-24 µm thick ........  O. braunii subsp. zehneri
  18. Oospore wall smooth ................ O. crassiusculum subsp. peshawarensensis
  18. Oospore wall longitudinally ribbed ...  O. cyathigerum

1.  Oedogonium undulatum (Breb.) A.Br. 1854.

   Dioecious, nannandrous, gynandrosporous or idioandrosporous; oogonium
   1-2, subglobose, or ellipsoid-globose, ocreolate, division inferior, wide; oospore
   globose or subglobose, quite filling oogonium, spore wall smooth, some times thick:
   androsporangium to 7 seriate; vegetative cells undulate; terminal cell (some times
   oogonium) apically obtuse; dwarf male elongate-obconic, usually on sulfuricary cell,
   rarely on other vegetative cell near oogonium; antheridium inferior; vegetative cell
   15-22 x 45-110 µm; oogonium 48-56 x 50-75 µm; oospore 42-50 x 42-52-(60) µm; androsporangium
   15-21 x 7-14 µm; dwarf male 8-10 x 48-65-(70) µm. (fig. 1).

   Distribution: U.S.A., China, Austria, England, France, Bangladesh, Pakistan.

2.  O. mitratum Hirn. 1895.
   Tiffany, 1930: p. 105, pl. 36, fig. 334-335.

   Dioecious, macrandrous; oogonium 1-4, globose or subglobose, ocreolate
   division supermedian or superior, narrow but distinct; oospore globose (rarely subglobose),
   filling oogonium, spore wall smooth; antheridium 1-5, subepigynous, sperm
   2, division horizontal; vegetative cells often broadly capitellate, vegetative cell 5-10
   x 18-80 µm; oogonium 18-24-(27) x 20-28 µm; oospore 17-23 x 17-22 µm: antheridium
   6-9 x 6-8 µm. (fig. 2).

   Locality: Karamar Hills, (Sardar Hussain Shah No.1, 1964.)
   Distribution: U.S.A., Austria, Finland, Sweden, Pakistan.

3.  O. decipiens Wittr. 1870.
   Tiffany, 1930: p. 145, p1. 45, fig. 520.

   Dioecious, nannandrous, gynandrosporous; oogonium 1-3, subdepressed or
   depressed-globose, ocreolate, division median, rather narrow; oospore subdepressed
or depressed-globose, almost filling the oogonium. Spore wall smooth; suffrutescent cell not swollen; androsporangium 1-6, subepigynous, hypogynous, or scattered; dwarf male unicellular usually on the oogonium; vegetative cells evidently capitate, 8-11 x 25-65 \( \mu m \); oogonium 28-35 x 23-38-(40.7) \( \mu m \); oospore 23-34 x 21-30 \( \mu m \); androsporangium 8-9 x 6-10 \( \mu m \); dwarf male 5-6(12.1) x 11-14-(17) \( \mu m \). (fig. 3).

**Locality:** Mardan. Fazle Khaliq. No. 90, 2.5.75


4. *O. ahmadii* Farooq & Faridi sp. nov.

Species monoecia, macrandra; oogonium unicum; subglobosum ad subovoidem; porus superior; oospora globosa, oogonium non complens; membrana oosporae levii; antheridia duo, subepigyna; spermata duo, divisione horizontali; cellula vegetativa late capitellata, 13-17.7 x 33-74.8 \( \mu m \); oogonium 39-50.6 x 38-52.6 \( \mu m \); oospora 33-49.5 x 33-49.5 \( \mu m \); antheridium 13-22.1 x 8-22.2 \( \mu m \); filamentum masculum nanum 6.6-17.7 \( \mu m \).

Monoecious, macrandrous; oogonium 1, subglobose to subovoid; pore superior; oospore globose, not filling oogonium; spore wall smooth; antheridium horizontal; vegetative cells broadly capitellate, 13-17.7 x 33-74.8 \( \mu m \); oogonium 39-50.6 x 38-52.6 \( \mu m \); oospore 33-49.5 x 33-49.5 \( \mu m \); antheridium 13-22.1 x 8-22 \( \mu m \); dwarf male 6.6 x 17.7 \( \mu m \). (fig. 4).

**Habitatus:** Mardan. Holotype No. T 121. (Fazle Khaliq No. 92, 25.2.75.)

This species is named after Dr. Sultan Ahmad, Government College, Lahore. The type specimen is deposited in the Herbarium of Department of Botany, University of Peshawar.

5. *O. hirnii* ssp. africanum G. S. West.

Tiffany 1930: p. 73, pl. 14, fig. 138.

Monoecious. oogonium 1 subglobose-obovoid-globose, with superior pore; oospore filling oogonium. Spore wall smooth; antheridium 1-2, sperms 2, division horizontal; vegetative cell cylindrical (sometimes slightly capitellate) 16-22 x 51-77 \( \mu m \);

Oogonium 32-66 x 35-60 \( \mu m \); Oospore 30-64 x 34-58 \( \mu m \); antheridium 13-14 x 5-6 \( \mu m \). (fig. 5).

**Locality:** Mardan. (Fazle Khaliq No. 90(a), 15-4-75.)

**Distribution:** U.S.A., Africa, Pakistan.


Tiffany 1930: p. 161, pl. 34, fig. 316.

Oogonium 1 (rarely 2), subbiconic-ellipsoid or subbiconic-globose. Seen from above circular, margin even, operculate, division wide; oospore ellipsoid or globose, generally constricted at the middle, not quite filling oogonium. Spore wall smooth; basal cell sub-hemispherical; terminal cell obtuse or obtusely conical; vegetative cell 3-6(6.6) x 10-60 \( \mu m \); oogonium 14-16 x 15-25 \( \mu m \); oospore 11-13 x 13-15 \( \mu m \); basal cell 7-8 x 7-8 \( \mu m \); male filaments 11-18.7 x 19.8 \( \mu m \). (fig. 6).
Plate I. Fig. 1 O. undulatum, 2 O. miratum, 3 O. decipiens, 4 O. ahmadit, 5 O. hirmiti subsp. africanum, 6 O. pusillum, 7 O. magnusii, 8 O. crytoporum subsp. vulgare, 9 O. frutescens var. exiguum, 10 O. franklinianum, 11 O. variant, 12 O. dictyosporum, 13 O. hirmiti, 14 O. crassum, 15 O. scordiculatum, 16 O. argenteum, 17 O. willett.

Distribution: U.S.A., Austria, France, Africa, Bangladesh, Pakistan.

This species was incompletely known as male plants were unknown. In this collection male plants are also present.
   Tiffany 1930: p. 68, pl. 12, fig. 115.

   Dioecious, macrandrous, (perhaps monoecious also); oogonium 1-3, depressed-globose, pore median, rhipiform; oospore depressed globose, quite filling oogonium, spore wall of three layers: outer layer smooth, middle layer scrobicate, inner layer smooth; antheridium 8-10 x 8-12 μm; sperm 1; vegetative cell 12-18 μm; oogonium 24-27 x 26-33 μm; oospore 22-25 x 18-23 μm; antheridium 8-10 x 5-11 μm. (fig. 7).

   **Locality:** Peshawar University Town (S. Farooq No. 64(a), 12-3-1975).
   **Distribution:** U.S.A., Europe, Pakistan.

   Tiffany 1930: p. 65, pl. 11, fig. 101.

   Monoecious; oogonium 1, subdepressed-obovoid-globose, or subdepressed-globose, pore median; oogonium quite filling, spore wall smooth, antheridium 1-7, scattered or subhypoapogynous or subepigynous; sperms 1; vegetative cell 5-8 x 15-48 μm; oogonium 1-1; oogonium 18-25 x 18-25 μm; spore wall pitted, oospore 16-23 x 16-19 μm; antheridium 5-7 x 9-12 μm. (fig. 8).

   **Locality:** Peshawar, S. Farooq No. 8, 1-2-1975.
   **Distribution:** U.S.A., Sri Lanka, Europe, Pakistan.

   Tiffany 1930: p. 66, pl. 11, fig. 106.

   Dioecious, macrandrous; oogonium 1-3 obvoid or depressed-obvoid-globose, filling oogonium or nearly so, spore wall smooth; antheridium 1-3; vegetative cell 5-9 x 22-88 μm; oogonium 22-24 x 20-28 μm; oospore 20-22 x 17-28 μm; antheridium 3-5 x 10-12 μm. (fig. 9).

   **Locality:** Peshawar (S. Farooq No. 7, 1-2-1975).
   **Distribution:** U.S.A., Albania, France, China, Pakistan.

    Tiffany, 1930: p. 71, pl. 13, fig. 131.

    Dioecious, macrandrous; oogonium 1, subglobose with a supramedian pore: oospore globose, almost filling oogonium, spore wall smooth; antheridium 1-4; sperms 2, division horizontal; female vegetative cell 9-12 x 30-95 μm; male 8-10 x 25-90 μm; oogonium (22) 26-31 x (18) 29-44 μm; oospore 24-30 x 24-30 μm; antheridium 8-9 x 5-7 μm. (fig. 10).

    **Locality:** Peshawar University. S. Farooq No. 63, 2-3-75.
    **Distribution:** U.S.A., Brazil, Australia, Pakistan.

    Tiffany, 1930: p. 69, pl. 12, fig. 120.

    Monoecious, (or sometimes dioecious); oogonium 1, or rarely more, depressed-or subdepressed-pyriform-globose, pore nearly superior; oospore globose, not filling
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Oogonium, spore wall smooth; antheridium to 9-seriate, scattered; sperms 2, division horizontal; basal cell elongate; terminal cell apically obtuse; vegetative cell (8.8)-12-16 x 35-144 μm: oogonium (32)-34-50 x 34-55 μm: oospore 31-41 x 31-41 μm: antheridium (8)-11-15 x 5-7 μm. (fig. 11).

Locality: Peshawar University Town, (S. Farooq No. 64(b), 12-3-1975.)
Distribution: U.S.A., Europe, Pakistan.

Peshawar specimens are smaller in dimension than the type.

12. O. dictyosporum Wittr. 1874.
Tiffany, 1930: p. 94, pl. 28, fig. 246.

Monoecious: oogonium 1-2, dark brown, obvoid globose with superior pore; oospore globose to ellipsoid-globose, usually not filling oogonium; outer wall of the oospore is reticulate, inner smooth; antheridium 1-3, subepigynous: sperms 2; vegetative cell 11-16 x 23-95 μm: oogonium (29.7)-33-40 x 38-46 μm: oospore 28-39 x 30-40 μm: antheridium 8-13 x 5-10 μm. (fig. 12).

Locality: Tarujabba, (S. Farooq No. 11, 3-2-75.)

Oogonium is smaller than the type and becomes dark brown in colour at maturity.

Tiffany, 1930: p. 73, pl. 14, fig. 136-137.

Monoecious: oogonium 1, subglobose or subovoid, with superior pore; oospore globose, not filling oogonium, spore wall smooth; antheridium 1-2, subepigynous: sperms 2, division horizontal: vegetative cell cylindrical, (sometimes slightly capitellate) 8-13 x 28-30-(33) μm: oogonium 32-37 x 32-39 μm: oospore 28-31 x 28-31 μm: antheridium 8-11 x 4-9 μm. (fig. 13).

Locality: Akbarpur, (S. Farooq No. 13, 7-3-1975.)
Distribution: Austria, Ireland, Bangladesh, Pakistan.

The oospore is broad and almost equal in length to the length of vegetative cell.

Tiffany 1936: p. 88, pl. 23, fig. 202-203.

 Dioecious, macandrous: oogonium 1-2, ovoid to obovoid-ellipsoid; pore superior; oospore ellipsoid to globose, filling or not filling oogonium, spore walls smooth; antheridium 2-25; sperms 2, division vertical: female vegetative cell 36-50 x 72-340 μm: male 30-36 x 72-260 μm: oogonium 60-75 x 85-120 μm: oospore 58-76 x 75-96 μm: antheridium (20.7)-28-32 x 10-20 μm. (fig. 14).

Locality: Pabbi, (S. Farooq No. 9, 15-3-1975.) and Tarujabba. (S. Farooq No. 5, 3-2-1975.)
The male filaments are very thin (about few microns). The oogonium is more urn-like than the type specimen.

   Tiffany, 1930: p. 95, pl. 29, fig. 258-259.

Dioecious, macrandrous; oogonium 1-3, obovoid or subellipsoid, pore superior; ooosporo of same form as oogonium and nearly filling it, outer spore wall scrobiculate, inner smooth; antheridium 1-many, sperms 2, division horizontal; female vegetative cell 16-24 x 50-144 μm; male 15-19 x 45-110 μm; suffultory cell 21-30 x 34-90 μm; oogonium obovate, 40-48 x 60-88 μm; ooosporo 39-45 x 48-57 μm; antheridium 13-15 x 8-12 μm. (fig. 15).

*Locality:* Peshawar, (S. Farooq, No. 3, 4-4-1975.)
*Distribution:* U.S.A., Denmark, Pakistan.

   Tiffany, 1930: p. 96, pl. 29, fig. 253-254.

Dioecious, macrandrous; oogonium 1, obovoid-globose to globose, pore superior (rarely supramedian); ooosporo ovoid to globose, outer layer of spore wall scrobiculate; antheridium 3-4, sperms 2, division horizontal; basal cell elongate; female vegetative cell (14)-20-28 x 80-160 μm; male 20-22 x (47)-70-160 μm; oogonium 44-52 x 48-62 μm; antheridium 22 x 8 μm. (fig. 16).

*Locality:* Peshawar (G.T.S. Workshop) S. Farooq No. 14, 7-3-75, and Akbarpura, S. Farooq, No. 16, 7-3-1975.
*Distribution:* U.S.A., Brazil, Pakistan.

17. *O. wylici* Tiffany 1926.
   Tiffany, 1930: p. 97, pl. 30, fig. 264-267.

Dioecious, macrandrous; oogonium 1-4, globose to ovoid, pore superior; ooosporo globose to ovoid, filling or not filling oogonium, outer spore wall irregularly scrobiculate; antheridium 1-4; sperms 2, division horizontal; basal cell elongate; terminal cell, often an oogonium, apically obtuse or broadly apiculate; vegetative cell 16-24 x (73)-80-170 μm; oogonium 52-64 x 68-112 μm; ooosporo 48-60 x 52-64 μm; antheridium 16-19 x 8-18 μm. (fig. 17).

*Locality:* Pabbi, (S. Farooq No. 67, 15-3-1975.)
*Distribution:* U.S.A., Pakistan.

The species is first reported from the U.S.A. and it is the first report outside U.S.A.

   Tiffany, 1930: p. 120, pl. 43, fig. 417.

Dioecious, nannandrous, gynandrosporous, (or possibly idioandrosporous); oogonium 1, ellipsoid, poremedian; ooosporo ellipsoid, nearly filling oogonium, outer spore wall echinate; androsporangium 1-3; terminal cell obtuse, dwarf male slightly curved, on suffultory cell; antheridium exterior, 1; vegetative cell 17-28 x 30-120 μm;
oogonium 38-48 x 45-65 µm; oospore 37-46 x 43-55 µm; androsporangium 17-18 x 13-18 µm; dwarf male stipe 10-11 x 22-25 µm; antheridium 5-8 x 9-14 µm. (fig. 18).

Locality: Tarujabba, (S. Farooq No. 10, 3-2-1975.)
Distribution: U.S.A., Germany, Sweden, Pakistan.

Plate II. Fig. 18 O. hystrix, 19 O. semiapertum, 20 O. braunii subsp. zehneri, 21 O. crassum subsp. peshawarensis, 22 O. cyathigerum

19. O. semiapertum Nordst. and Hirn 1900.
Tiffany, 1930: p. 124, pl. 44, fig. 445.

Dioecious, nannandrous, gynandrosporous; oogonium 1 (rarely 2), subhexagonal-globose to subpyriform-globose, pore median, rimiform extending nearly half way round the oogonium; oospore globose or subglobe, not filling oogonium, spore wall smooth; androsporangium 1-3, hypogynous or subepigynous; terminal cell apically obtuse; dwarf male subobovoid, on oogonium; antheridium interior; vegetative cell 9-12 x 38-105 µm; oogonium 32-35-(36.3) x 33-40 µm; oospore 25-29 x 25-30 µm; androsporangium 9-10 x 10-14 µm; dwarf male 8-9 x 14-15 µm. (fig. 19).

Locality: Peshawar, S. Farooq No. 4, 4-4-1975.
Distribution: France, Guiana, Pakistan.

20. O. braunii Kg. ssp. zehneri Tiffany 1927.
Tiffany 1930: p. 125, pl. 47, fig. 459.

Dioecious, nannandrous, gynandrosporous; oogonium 1, ovoid to subglobe, pore median; oospore globose to ovoid, not filling oogonium, spore wall smooth; androsporangium 1-2; basal cell elongate; terminal cell apically obtuse; dwarf male usually on suffultory cell, stipe somewhat curved; antheridium exterior, 1; vegetative
cell 12-24 x 34-72 μm; suffractory cell 21-32 x 48-52 μm; oogonium 40-50 x 48-60 μm; oospore 34-44 x 36-50 μm; dwarf male stipe 8-10 x 16-24 μm; antheridium 7-8 x 8-12 μm. (fig. 20.)

Peshawar, S. Farooq No. 5, 18-2-1975.

Distribution: U.S.A., Pakistan.


Oogonium 1-2, globose-ovato-subglobosum; porus superior, oospore ellipsoidio-globosa, oogonium complens; membrana oosporae levis, incrassata; cellula suffratoria cylindrica; cellula vegetative 21-29 x 320-110 μm; oogonium 25.3-31.4 x 42-65 μm; oospore 23-29 x 40-65 μm.

Oogonium 1-2, globose-obovoid or subglobose; pore superior; oospore ellipsoid-globose; spore wall smooth, thickened, filling the oogonium; suffractory cell cylindrical; vegetative cell 21-29 x 32-110 μm; oogonium 25-3-31.4 x 42-65 μm; oospore 23-29 x 40-65 μm. (fig. 21).

Habitat: Peshawar (S. Farooq No. 6, 1-12-1974). Holo type No. 12D.

Locality: Peshawar, S. Farooq No. 6, 1-12-1974 Type specimen has been deposited in the Herbarium of Botany Department, Peshawar University (No. 120).

The subspecies has smaller vegetative cells, oogonia and oospore as compared to the type species.


Tiffany, 1930: p. 133, pl. 51, fig. 484-485.

Diocious, nannandrous, idiobisterosporous; oogonium 1-3, subovoid or quadrangular-ellipsoid, pore superior; oospore same form as oogonium, filling it, outer layer of spore wall smooth, median layer with 16-25 longitudinal continuous, rarely anastomosing, often curved, edges-inner layer smooth; basal cell elongate; terminal cell often a oogonium, obtuse; dwarf male goblet-shaped, curved, on the suffractory cell or oogonium; antheridium interior; vegetative cell 21-30 x 40-300 μm; suffractory cell 42-48 x 75-110 μm; oogonium 57-56 x 70-100 μm; oospore 51-62 x 60-75 μm; androsporangium 23-30 x 12-30 μm; dwarf male cell 12-15 x 50-58 μm (fig. 22).

Locality: Pabbi, (S. Farooq No. 68, 15-3-1975).

Distribution: U.S.A., Europe, Germany, Pakistan.

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