

Morpho-Taxonomic Studies on the Genus *Spirogyra* Link (Chlorophyta) Occuring in Fresh Water Bodies of Jammu, Jammu And Kashmir

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Abstract: Sixteen species of *Spirogyra* Link 1820 (Zygnemophyceae, Chlorophyceae) were collected during 2008 to 2010 from different freshwater habitats of three districts of Jammu province viz., Samba district, Jammu district and Udhampur district. They were taxonomically determined on the basis of vegetative structure and reproductive structure. Their reproduction was mostly studied during winters and spring seasons. Both lateral conjugation and scalar form conjugation were observed. The scalariform conjugation was most common type of conjugation method among species. *S. calcarea*, *S. rectispire*, *S. submarina*, *S. hollandiae* and *S. buchetii* were taxonomically determined and have been described for first time in India and Jammu. Their reproduction was observed to occur mostly in winter and spring season. All sixteen species were found abundantly in both lentic and lotic water habitat.

Key words: *Spirogyra*, Vegetative Structure, Reproductive structure, Lateral conjugation, Scalariform conjugation, morpho-taxonomic, lentic and lotic water bodies.

I. Introduction

The occurrence of Zygnematales in India was reported by Martens (1869). Lateron, Danforth (1910) and Carter (1926) studied the periodicity and occurrence of *Spirogyra* in winter season from high altitude of Missouri, Assam and Sikkim. Randhawa (1940) recorded various filamentous green algae occurring in India and compiled a monograph of *Zygnema* in 1959. Lateron, Kumar & Singh (1984) reported new species of *Spirogyra* from Uttar Pradesh

In Jammu, prior work on Zygnematales was done by Misra (1937), he worked on four new taxa and recorded the distributed of seventeen more taxa belonging to genus *Spirogyra* and *Zygnema* growing in waters of Jammu & Kashmir. He also recorded the occurrence of five species of *Spirogyra* from fresh water of Jammu.

The study on distribution and morphology of Zygnematales was further proceeded by Kant (1974) he studied that *Spirogyra* formed 80% of its population in Lakes of Srinagar. Goyal et al, (1984) and Anand (1988) reported the occurrence of *Spirogyra* species in fresh water of Jammu.

Since then no much work had been done in the field of taxonomic studies of *Spirogyra* growing in Jammu waters. Keeping in view the paucity of the work done on morphology and taxonomic studies on *Spirogyra*, an extensive survey had been conducted in three districts of Jammu (Jammu, Samba and Udhampur) from 2008 to 2010. While surveying various local water bodies like pond, puddles, road side ditches, lakes, slow moving streams, rivers etc. sixteen species of *Spirogyra* were studied, of which five species i.e., *S. calcarea*, *S. rectispire*, *S. submarina*, *S. hollandiae* and *S. buchetii* were new to Indian taxonomy.

II. Materials And Methods

Collections were made from Samba, Udhampur and Jammu districts of Jammu province during the period of January 2008 to March 2010. The specimens were obtained by hand-picking from various freshwater habitats like fountain water, running water channels, stagnant ponds and road-side puddles. They were preserved in glass bottles containing 5% formalin and brought to the laboratory, where they were stained in iodine solution and examined in 10% glycerin mounts under light microscope. Their drawings were made with the help of camera lucida and was micro photographed. The material was taxonomically determined with the help of authentic literature (Randhawa, 1959; Transeau, 1951; Chin-Chin, 1982; Vidyavati, 1995; Kargupta and Jha, 2004; Taft, 2009).

III. Results

Sixteen species of pond scum genus *Spirogyra* (phylum Chlorophyta, class Chlorophyceae, order Zygnematales, family Zygnemetaceae) have been identified. Their taxonomic enumeration is as follows:

Spirogyra Link 1820

The genus *Spirogyra* was founded by Link in 1820 and is represented by large number of species, filaments are free floating and rarely attached.

Vegetative features: Cells are cylindrical, 0.5-30 μ times as long as broad; chloroplast 1- 16 μ spirally arranged; parietal ribbon-like bodies with numerous prominent pyrenoids; nucleus centrally situated in a protoplasmic strand.

Reproductive features: Reproduction by zygospores, parthenosore, aplanospores, akinetes or by fragmentation; conjugation scalariform or lateral; zygospores usually ellipsoid, rarely ovoid or lenticula; median wall pale yellow to chestnut brown in colour; either smooth or variously ornamented.

The following sixteen species were collected which may be distinguished as follows:

Key to the local species of genus *Spirogyra*

1	Reproduction by Zygospores.....	2
2	Cross walls plane.....	3
3	(a) Chloroplast one in each cell.....	4
3	(b) Chloroplast many in each cell.....	5
4	(a) Gamentangia cylindric or enlarged.....	6
6	(a) Vegetative cell 18-26 μ broad.....	<i>S. communis</i>
6	(b) Vegetative cell 29-39 μ broad.....	<i>S. singularis</i>
4	(b) Gamentangia swollen on both sides.....	<i>S. teodoresis</i>
4	(c) Gametangia swollen on outer sides.....	7
7	(a) Vegetative cells 30-35 μ broad.....	<i>S. borgeana</i>
7	(b) Vegetative cells 37-42 μ broad.....	<i>S. calcarea</i>
5	(a) Zygospores laterally compressed.....	8
8	(a) Zygospores ellipsoid.....	<i>S. crossoidea</i>
8	(b) zygospores ovoid.....	<i>S. rectispera</i>
5	(b) Zygospores not laterally compressed.....	9
9	(a) Gametangia cylindric.....	10
10	(a) Zygospores ellipsoid.....	11
11	(a) Veg.cell 21-32 μ broad.....	<i>S. submarina</i>
11	(b) Veg. cell 32-37 μ broad.....	<i>S. irregularis</i>
11	(c) Veg. cell 36-41 μ broad.....	<i>S. hollandiae</i>
11	(d) Veg. cell 45-60 μ broad.....	<i>S. hyaline</i>
11	(e) Veg. cell 55-60 μ broad.....	<i>S. pseudoneglata</i>
11	(b) Zygospores cylindric ovoid.....	<i>S. neglecta</i>
9	(b) Gametangia swollen.....	12
12	(a) Chloroplasts 3-4 in each cell.....	<i>S. paradoxa</i>
12	(b) Chloroplasts 2-3 in each cell.....	<i>S. dubia</i>
12	c) Chloroplast 2 un each cell.....	<i>S. buctei</i>

1. *Spirogyra communis* (Hassal) Kutzin.

(Randhawa, 1959. Zygnemataceae :247-293; Shameel,2006:p. 228; Pandoh, plate-VIII, Figs.40-43, 188-190)

Habitat and Habit: Lentic water conditions ; Free floating.

Vegetative feature: Vegetative cells 18 -25 μ x 40-75 μ ; end wall plain ; chloroplast 1, making 1.5-4 turns (Plate-I; Fig.1).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gamentangia; fertile cell cylindrical ,rarely enlarged; Zygospores ellipsoid to ovoid, 19-25 μ \times 42-78 μ ; medium spore wall yellow and smooth (Plate-I; Fig.2&3).

Geographical distribution:

World : New Caledonia (U.S.A), North- east Pakistan, Poland

India: Gorakhpur (U.P), Assam.

Jammu: Paddy fields of Seri, Bandhu Rakh stream (12-1-2008), Pond of Bagh-e- Bahu (8-2-2009), Seasonal pond of Sagoon (19-10-2008).

Variations recorded : This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions, number of spiral turns of chloroplast, conjugation types differed from scalariform to lateral. Zygospore variations also differed

2. *Spirogyra singularis* Nordstedt.

(Randhawa, 1959, The Zygnemataceae : p.295,251; Hashaw et al.1985. 1005-1011; Wang et al, 1989: 367-373).

Habitat and Habit: Lentic water condition ; Free floating.

Vegetative feature: vegetative cells $25 \times 35\mu \times 80-105\mu$; end wall plain ; chloroplast 1, making 2-3.5 turns (Plate-I; Fig.4).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gametangia; fertile cell centric ,rarely enlarged; Zygospores ellipsoid to oval, $23-32 \times 45-65 \mu$; medium spore wall yellowish brown and smooth (Plate-I; Fig5&6).

Geographical Distribution:

World : China, South Africa, Brazil, Finland, New Zealand and U.S.A.

India: Bombay, Banaras, U.P, Punjab.

Jammu: Paddy fields of Raipur (13-8-2009), River Tawi (3-1-2009), Pond of Bagh- e- Bahu (8-2- 2009), ditches along the main stream , Jhajjar Kotli (27-11-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles and is rice field after monsoons. This species is highly variable in cell dimensions, number of spiral turns of chloroplast , turns varied from 3-7 . Zygospore variations also differed

3. *Spirogyra teodoresci* Transeau.

(Transeau ,1934. Ohio. Jour. Sci. 34, p.420; Randhawa, 1959, The Zygnemataceae : p.296,255; Shameel,2006. p.246, fig IV,41 a-b).

Habitat and Habit: Lentic water condition ; Free floating.

Vegetative feature: Vegetative cells $20 \times 30\mu \times 42-80\mu$; chloroplast 1, making 1-2 turns (Plate-I; Fig-7).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gametangia; fertile cell slightly swollen on conjugation side ; Zygospores oval, $28-32 \times 58-74 \mu$; medium spore wall yellowish brown and smooth (Plate-I; Fig-8).

Geographical distribution:

World : Nanking, Peiping, China, Humania, U.S.A, Arizona, Pakistan

India: Not reported earlier.

Jammu: Slow moving stream Pragwal (2-3-2008), River Tawi tributary (14-12-2008), Lake Mansar (10-2-2009), ditches along the main stream at Jhajjar Kotli (4-1-2009).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions, number of spiral turns of chloroplast , turns varied from 1-6 . Zygospore variations also differed from $50-78 \mu$ to $52-80\mu$.

4. *Spirogyra borgeana* Transeau.

(Transeau .1951. Ohio. Jour. Sci. 34, p.420; Randhawa, 1959, The Zygnemataceae; Shameel,2007. p.246, fig IV,41 a-b).

Habitat and Habit: Lentic water condition ; Free floating / Epiphytic on *Potamogeton* sp.

Vegetative feature: vegetative cells $35-48\mu \times 58-120\mu$; chloroplast 1, making 1-2 turns.

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gametangia; fertile cell inflated on the outer side ; Zygospores ovoid to ellipsoid, $38-50 \times 60-125 \mu$; medium spore wall brown; mesospore 2 layered and smooth (Plate-I; Fig-9).

Geographical distribution:

World : Tibet, China, U.S.A, Pakistan

India: Not reported earlier.

Jammu: Pond in Botanical Garden, JU (7-01-2009), Lake Surinsar (4-1-2008), ditches along the road side at Bishnah (15-3-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions, number of spiral turns of chloroplast, turns varied from 1.5-5. Zygospore varied in shape, oval to ellipsoid and yellow to brown, respectively.

5. *Spirogyra calearea* Transeau.

(Transeau, 1951, p.226; Randhawa, 1959, The Zygnemataceae, p 413, fig. 499).

Habitat and Habit: Lentic water condition ; Free floating / Epiphytic on *Potamogeton* sp.

Vegetative feature: Vegetative cells 38-40 μ x 60-75 μ ; chloroplast 1, making 2-2.5 turns (Plate-I; Fig-10).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gametangia; receptive gametangia inflated only on the outer side ; Zygospores ellipsoid, 40-45 x 65-78 μ ; medium spore wall yellowish brown; smooth (Plate-I; Fig-11).

Geographical distribution:

World : U.S.A.

India: Not reported earlier.

Jammu: Ditches at Pragwal (17-10-2008), Slow moving stream at Bandhu Rakh (27-10-2008), Agricultural fields at Tikri, Udhampur (12-10-2009), Permanent pond at Sagoon (21-10-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions, number of spiral turns of chloroplast, turns varied from 2-3. Nature of reproductive cells show difference viz., fertile cells inflated on conjugating scale or inflated completely. Zygospores varied in dimension, shape, colour and nature showed variability.

6. *Spirogyra crassoidea* Transeau.

(Transeau, 1951, p.936; Randhawa, 1959, The Zygnemataceae, p.377 fig. 415; Khan and Usha, 1971. Biology of Conjugales p.124-125; Shameel, 2007. p.229, fig. 1,6).

Habitat and Habit: Lentic water condition ; Free floating.

Vegetative feature: Vegetative cells 140-145 μ x 180-320 μ ; chloroplast 3, making 2-2.5 turns in each cell (Plate-I; Fig- 12).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gametangia; fertile cells cylindrical and slightly swollen on the inner side ; Zygospores ellipsoid, 125-140 μ x 150-220 μ ; medium spore wall brown; smooth (Plate-I; Fig-13).

Geographical distribution:

World : U.S.A, Brazil, India, Pakistan.

India: Punjab, Dehradun, U.P.

Jammu: Seasonal pond at village Gho Manasha (15-11-2008), Slow moving stream at Samba (5-2-2008), Jhajjar Nallah (7-10-2008), Lake Mansar (12-1-2009), Seasonal pond at Sagoon (3-3-2008), Paddy Field at R.S.Pura (27-11-2009).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions, number of spiral turns of chloroplast, turns varied from 1-6. Nature of reproductive cells show difference viz., fertile cells inflated on conjugating scale or inflated completely. Zygospores varied in dimension, shape, colour and nature showed variability.

7. *Spirogyra rectispira* Merriman .

(Merriman 1922. Amer. Journ.Bot.9, p. 283 ; Randhawa, 1959, The Zygnemataceae, p.415 ; Kargupta, 1998).

Habitat and Habit: Lentic water condition ; Free floating.

Vegetative feature: Vegetative cells 130-170 μ x 80-280 μ ; plain end walls; chloroplast 12-14, making 1-1.5 turns in each cell (Plate-I; Fig-14).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gamentangia; fertile cells cylindric and slightly enlarged on the inner side ; Zygospores ellipsoid to ovoid, 155-145 μ x 100-120 μ ; brown (Plate-I; Fig-15).

Geographical distribution:

World : U.S.A.

India: Not reported earlier.

Jammu: Man made pond at Bagh-e-Bahu (5-2-2008) .Athum pond at Jammu-Surinsar road (19-8-2008), Seasonal pond at Sagoon (4-1-2009), Paddy Field at Raipur (27-09-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions , chloroplast number varied from 2-3 , turns varied in number. Zygospores varied in dimension ,shape, colour and nature showed variability.

8. *Spirogyra submarina* Collins .

(Transeau.1951. Ohio.Journal. Sci. p.25 ; Randhawa, 1959, The Zygnematace, p.415 ; Hoshaw.1968. p.65 , figs. 34-35; Wang. 1989. P.368; Dias.2006. p.400 ; Shameel.2007. p.244. fig.IV,38a).

Habitat and Habit: Lentic water condition ; Free floating.

Vegetative feature: Vegetative cells 20-35 μ x 68-155 μ ; plain end walls; chloroplast 3, making 2-3 turns in each cell (Plate-I; Fig-16) .

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gamentangia; fertile cells cylindric and slightly enlarged on the inner side ; Zygospores ellipsoid to ovoid, 25-37 μ x 55-125 μ ; brown (Plate-I; Fig-17).

Geographical distribution:

World : U.S.A, China, Brazil, Pakistan, Bermuda

India: Not reported earlier .

Jammu: Agriculture field Bishnah (12-8-2008), Paddy Field at R S Pura (07-09-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions , chloroplast number varied from 2-3 , turns varied in number. Zygospores varied in dimension ,shape, colour and nature showed variability

9. *Spirogyra irregularis* Nagelli .

(Nagelli.1849. In Kutzing Species Algarum. p. 440 ; Randhawa, 1959, The Zygnematace, p.316:90 ; Shameel.2007. p.235. fig.II,19a-b; Naskar et al.2009.p.189.fig. 6).

Habitat and Habit: Lentic water condition ; Free floating.

Vegetative feature: Vegetative cells 35-38 μ x 80-210 μ ; plain end walls; chloroplast 3-4, making 0.5-1 turns in each cell (Plate-II; Fig-18).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gamentangia; fertile cells cylindric and slightly enlarged on the inner side ; Zygospores ellipsoid to ovoid, 32-35 μ x 45-85 μ ; yellowish brown (Plate-II; Fig-19).

Geographical distribution:

World : Western and Central U.S.A, Pakistan.

India: Sunderbands.

Jammu: Ditches along the road side Bishnah (15-3-2008), Lake Surisar (6-12-2008), Permanent pond in Botanical Gardern JU (17-1-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions, chloroplast number varied, turns varied in number from 1.5-5. Zygospores varied in dimension, shape, colour and nature showed variability.

10. *Spirogyra hollandiae* Taft .

(Taft.1947. Ohio Jour.Sci. 47, p.173, fig. 9-11 ; Randhawa, 1959, The Zygnematace, p.407:486).

Habitat and Habit: Lotic water condition ; Free floating.

Vegetative feature: Vegetative cells 32-35 μ x 68-120 μ ; plain end walls; chloroplast 2, making 2-3 turns in each cell (Plate-II; Fig-20).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gamentangia; fertile cells cylindrical or slightly enlarged on the inner side ; Zygospores ellipsoid, 34-36 μ x 70-75 μ ; yellow to brown at maturity (Plate-II; Fig-21).

Geographical distribution:

World : Dutch New Guinea.

India: Not reported earlier

Jammu: Lake Mansar (15-08-2009), Permanent pond in Bagh-e-Bahu (7-1-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions, chloroplast number varied from 2-4, turns varied in number from 1-2.5. Zygospores varied in dimension, shape, colour and nature showed variability.

11. *Spirogyra hyaline* Cleve .

(Cleve. 1868. Nova Acta Reg. Soc. Sci. Upsali. Ser.3,6. p .17, pl.3, fig. 1-6; Randhawa, 1959, The Zygnematace, p.318:294 (a-c); Shameel,2007. p.234, fig. II, 17 a-b; Dias.2006. Hoshaw.1968. Naskar.2009.p.188,pl.2, fig. IV).

Habitat and Habit: Letic water condition ; Free floating.

Vegetative feature: Vegetative cells 45-50 μ x 150-200 μ ; plain end walls; chloroplast 4, making 2-2.5 turns in each cell (Plate-II; Fig-22).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gamentangia; fertile cells cylindrical; Zygospores ellipsoid, 48-52 μ x 155-175 μ ; brown (Plate-II; Fig-23).

Geographical distribution:

World : China, Sweden, U.S.A.

India: Widely distributed

Jammu: Slow- moving stream at Bandhu Rakh (15-08-2009), Permanent pond in Bagh-e-Bahu (7-1-2008), Agricultural field at Tikri (3-4-2008).\

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions, chloroplast number varied from 2-4, turns varied. Zygospores varied in dimension, shape, colour and nature showed variability.

12. *Spirogyra pseudoneglecta* Czurda .

(Czurda.1932. Susswasserflora Mitteleuropa. 9, p. 194 ; Randhawa, 1959, The Zygnematace, p.390:296 a-b).

Habitat and Habit: Letic water condition ; Free floating.

Vegetative feature: Vegetative cells 50-60 μ x 132-150 μ ; plain end walls; chloroplast 3, making 1.5-2 turns in each cell (Plate-II; Fig-24).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gamentangia; fertile cells cylindrical or swollen slightly ; Zygospores ellipsoid, 60-65 μ x 98-120 μ ; median spore wall reddish brown, mesospore 3 layered, smooth (Plate-II; Fig-25).

Geographical distribution:

World : Moravia.

India: M.P

Jammu: Slow- moving stream at Bandhu Rakh (15-08-2009), Permanent pond in Sagoon (7-1-2008), Agricultural field at Tikri (3-4-2008), Ditches of Pragwal (17-10-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions , chloroplast number varied, turns varied from 1-2, Nature of reproductive cell show difference viz., fertile cells inflated on conjugating scale or inflated completely . Zygospores varied in dimension ,shape, colour and nature showed variability.

13. *Spirogyra neglecta* (Hassall) Kutzing .

(Kutzing.1849. Species Algarum, p.441; Randhawa, 1959, The Zygnematace, p.324:308; Dias.2006.p.420; Naskar et al.,2009.p. 188, pl.1).

Habitat and Habit: Lentic/lotic water condition ; Free floating.

Vegetative feature: Vegetative cells 52-60 μ x 162-185 μ ; plain end walls; chloroplast 4, making 2-2.5 turns in each cell (Plate-II; Fig-26).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gametangia; fertile cells swollen slightly on the conjugating side ; Zygospores oval , 54-62 μ x 162-187 μ brown, mesospore, smooth (Plate-II; Fig-27).

Geographical distribution:

World : Brazil, China, Germany, Finland, U.S.A, Siam, South Africa, Macedonia, Java.

India: M.P, U.P. Calcutta, Punjab.

Jammu: Slow- moving stream near Surinsar (12-10-2009), ditches along the main stream Jhajjar Kolti (17-10-2008), Agricultural field at Tikri (6-11-2008), Ditches along the road side at Samba (4-1-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions , chloroplast number varied from 3-4. Zygospores varied in dimension ,shape, colour and nature showed variability.

14. *Spirogyra paradoxa* Rao .

(Rao.1937. J. Indian Bot. Soc.,16.p.281.fig.5; Randhawa, 1959, The Zygnematace, p.326:313).

Habitat and Habit: Lentic water condition ; Free floating.

Vegetative feature: Vegetative cells 80-92 μ x 70-85 μ ; plain end walls; chloroplast 3-4, making 1-2 turns in each cell (Plate-II; Fig-28).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gametangia; fertile cells swollen slightly on the conjugating side ; Zygospores oval , 82-95 μ x 72-89 μ ; yellowish brown at maturity; median spore wall 2 layered, smooth (Plate-II; Fig-29).

Geographical distribution:

India: U.P, Bihar.

Jammu: Slow- moving stream near Surinsar (12-10-2009), ditches along the main stream Jhajjar Kolti (17-10-2008), Agricultural field at Tikri (6-11-2008), Ditches along the road side at Samba (4-1-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions , number of chloroplast turns varied from 1-3.5. Shape of zygospores showed variation i.e, spherical to oval. Zygospores varied in dimension, shape, colour and nature showed variability. Layers of zygospores ranged from 2-3.

15. *Spirogyra dubia* (Kutzing) Czurda .

(Czurda.1932. Sussawasserflora Mitteleuropa 9, p. 188; Danforth.1910.p.51; Randhawa, 1959, The Zygnemataceae, p.329:317; Rattan.1968.Biology of Conjugules. P.109; Kargupta.1998. p.237; Dias.2006.p.399; Kim et al.,2006. p.297; Shameel.2007. p.230.fig.I.9 a-b).

Habitat and Habit: Letic water condition ; Free floating.

Vegetative feature: Vegetative cells 52-58 μ x 90-110 μ ; plain end walls; chloroplast 2, making 2-3 turns in each cell (Plate-II; Fig-30).

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gamentangia; fertile cells swollen slightly on the conjugating side ; Zygospores oval , 50-55 μ x 88-100 μ ;mesospores thick, smooth brown (Plate-II; Fig-31).

Geographical distribution:

World: Africa, Bulgaria, Egypt, North America

India: Jabbalpore,M.P, U.P.

Jammu: Slow- Fountain –cum-pond at Bikram Chowk (25-5-2009), ditches along the main stream Jhajjar Kolti (19-10-2008), A seasonal pond at Sagoon (7-3-2008), Ditches along the road side at Pragwal (17-2-2009).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions , number of chloroplast varied from 2-4, number of chloroplast turns varied from 2-4. Reproductive cell show slight variation in nature. Zygospores wall ranges from 2-3 and also showed variation in colour and ornamentation.

16. *Spirogyra buchettii* Petit.

(Petit.1913. Bull. Soc.Bot.De France. 60, pp 40-43; Randhawa, 1959, The Zygnemataceae, p.416; Rattan.1968. Biology of Conjugules. P.128).

Habitat and Habit: Letic water condition ; Free floating.

Vegetative feature: Vegetative cells 45-48 μ x 120-140 μ ; plain end walls; chloroplast 2, making 2-3 turns in each cell (Plate-II; Fig-32)..

Reproductive features : Conjugation Scalariform; conjugation canal is formed by both gamentangia; fertile cells inflated from outer side ; Zygospores ellipsoid to oval, 47-50 μ x 125-150 μ ;median spore wall yellow, mesospores 2 layered, smooth (Plate-II; Fig-133).

Geographical distribution:

World: China, Moracco, U.S.A.

India: Not reported earlier

Jammu: Slow- Fountain –cum-pond at Bikram Chowk (25-5-2009), Agriculture field Gajansoo (12-1-2008).

Variation recorded: This species was collected in winter seasons from the ditches, fields, ponds and puddles. This species is highly variable in cell dimensions , number of chloroplast varied, number of chloroplast turns varied. Reproductive cell varies viz, shortened oval inflated to 50-52 μ . Zygospores dimension and colour also showed difference.

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Plate I

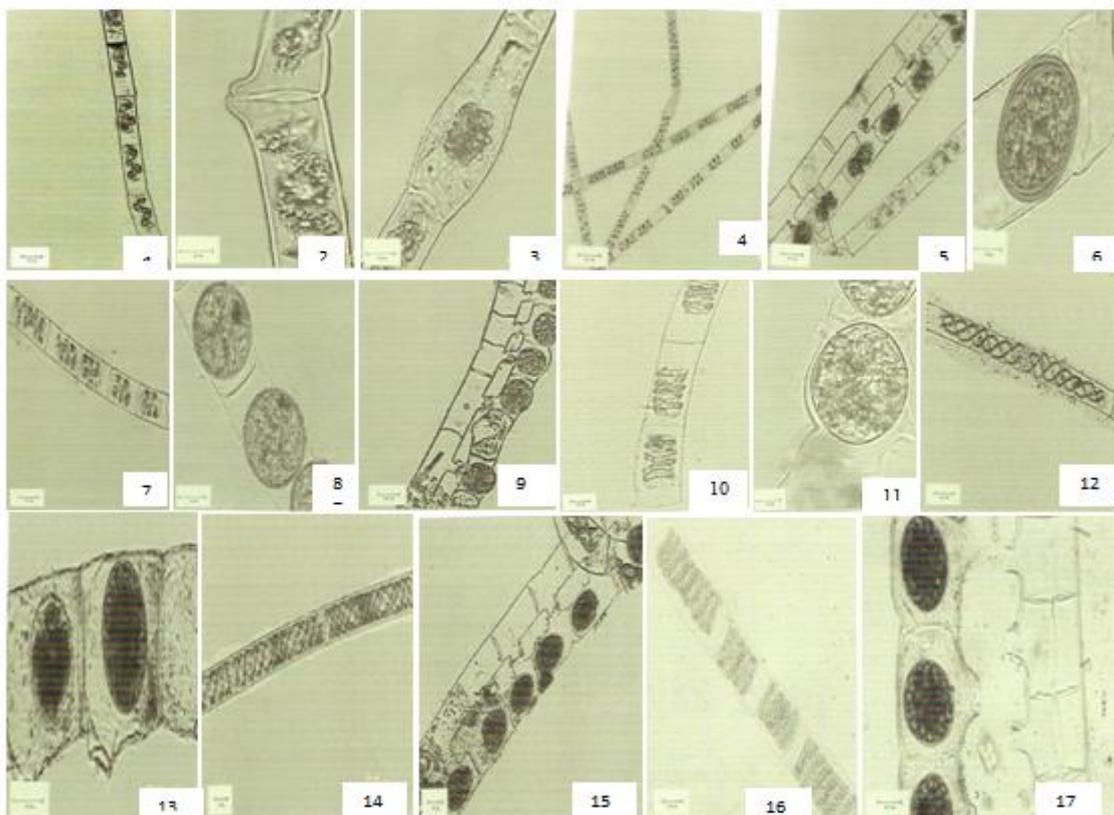


Fig.1- *S communis* vegetative filament; Fig.2- *S communis* Lateral conjugation; Fig.3- Alpanospore of *S communis*; Fig.4- *S singularis* Vegetative filament; Fig.5- *S singularis* Scalariform conjugation; Fig.6- Zygospore of *S singularis*; Fig.7- *S teodoresei* Vegetative filament; Fig.8- Zygospore of *S teodoresei*; Fig.9- *S borgeana* Scalariform conjugation; Fig.10- *S calcarea* Vegetative filament; Fig.11- *S calcarea* Zygospore; Fig.12- *S crassoidea* Vegetative filament; Fig.13- *S crassoidea* Receptive gametangia; Fig.14- *S rectispira* vegetative filament; Fig.15- *S rectispira* scalariform conjugation; Fig.16- *S submarina* vegetative filament; Fig.17- *S submarina* Scalariform conjugation.

Plate II

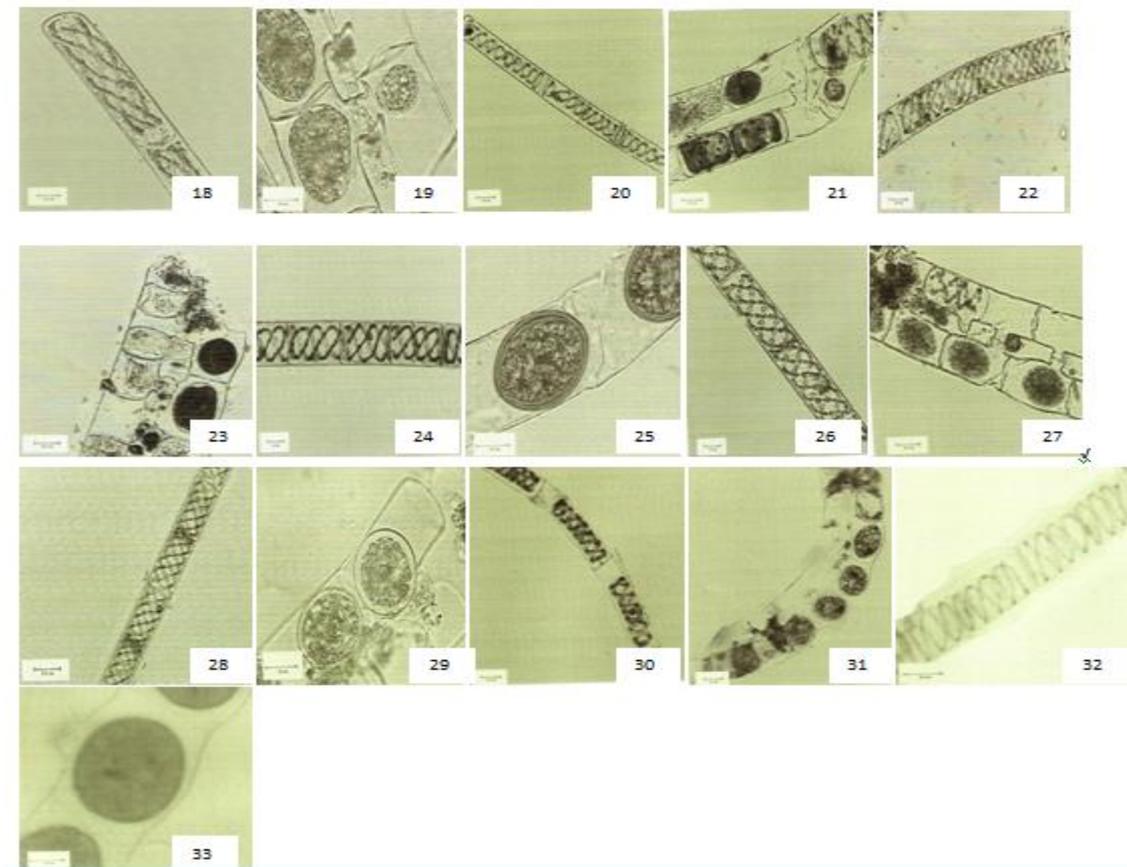


Fig.18- *S irregularis* vegetative filament; Fig.19- *S irregularis* scalariform conjugation and Zygospor formation; Fig.20- *S hollandiae* Vegetative filament; Fig.21- *S hollandiae* Scalariform conjugation; Fig.22- *S hyalina* Vegetative filament; Fig.23-*S hyaline* Scalariform conjugation; Fig.24- *S pseudoneglecta* vegetative filament; Fig.25- *S pseudoneglecta* Mature zygospor; Fig.26- *S neglecta* vegetative filament; Fig. 27-*S neglecta* Scalariform conjugation; Fig.28-*S paradoxa* vegetative filament; Fig.29- *S paradoxa* Mature zygospor; Fig.30- *S dubia* vegetative filament; Fig.31- *S dubia* Scalariform conjugation; Fig.32- *S buchetii* vegetative filament; Fig.33- *S buchetii* Zygospor.