

STUDIES ON THE GENUS *SPIROGYRA* LINK FROM ANDAMAN AND NICOBAR ISLANDS

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ABSTRACT

The paper describes 17 taxa of the genus *Spirogyra* Link having plain end-walls from Andaman and Nicobar Islands. It includes a new variety, *S. crassa* Kuetzing var. *minispora* var. nov., and a species, *S. distenta* Transeau, new to Indian flora.

INTRODUCTION

RANDHAWA (1959) has given a comprehensive account of the occurrence of various taxa belonging to the genus *Spirogyra* in India. While dealing with the floristic pattern and distribution of various algal groups, CARTER (1926), BISWAS AND CALDER (1936), BISWAS (1949 a, b), SRINIVASAN (1965) and SARMA AND KHAN (1980) have compiled the reports of *Spirogyra* species by other workers.

The Andaman and Nicobar archipelago, consisting of a cluster of 323 Islands, and having a total area of 8,293 sq km, lies between 6° and 14° north latitude and 92° and 94° east longitude on south-east Bay of Bengal. So far, no filamentous conjugate form has been recorded from this part of India. In the present paper, 17 taxa of the genus *Spirogyra* Link with plain cross-walls have been described from the different localities of Andaman Islands, along with their distribution on Indian mainland. This account includes a new variety *S. crassa* Kuetzing var. *minispora* var. nov. and records *S. distenta* Transeau for the first time from India.

Three species—*S. exilis* W. et G. S. West, *S. irregularis* Naegeli and *S. parvispora* Wood which have earlier been only enumerated in the checklists on algal floristics from three parts of India, have also been described here. While BENDRE *et al.* (1975) have recorded the first species from Uttar Pradesh, the second one is reported from Punjab by RATTAN (1963) and from Maharashtra by KAMAT (1974); the third one has been enlisted from Meerut by KUMAR (1975).

SYSTEMATIC DESCRIPTION

All the species have been arranged in alphabetic sequence. Collection numbers and dates are given in parentheses with the locality.

Spirogyra bichromatophora (Randhawa) Transeau

Text-figs. 29, 30

Transeau, E. N. 1951, p. 177, pl. 28, fig. 6 ; Randhawa, M.S. 1959, p. 328, fig. 315.

Vegetative cells 57-62.5 μm broad, 95-120 μm long, end-walls plane; each cell with two chloroplasts making 4-6 turns; conjugation scalariform, large tubes formed by both gametangia; fertile cells cylindrical or slightly enlarged: zygospores ellipsoid, 48-52.5 μm broad, 68-76 μm long; median spore wall smooth, light brown.

Locality—Pond at Astinabad, Port Blair (Coll. no. 254, Coll. date 8-11-1978) ; Ditch at Jukatang, South Andamans (Coll. no. AN 833, Coll. date 11-11-1981).

Distribution—Maharashtra (Dixit, 1937 from Bombay as *S. bimorphis* Dixit; Kamat, 1975 from Vidarbha) ; U. P. (Randhawa, 1938a from Fyzabad as *S. gallica* Petit var. *biechromatophora* Randhawa ; Khan & Usha, 1971 from Dehradun) ; Gujarat (Patel & Asoka Kumar, 1975a from Lunawada).

***Spirogyra condensata* (Vaucher) Kuetzing**

Text-figs. 11, 12

Borge, O. 1913, p. 25, fig. 25 ; Czurda, V. 1932, p. 178, figs. 185-186 as *S. condensata* (Vauch.). Czurda ; Kolkwitz, R. & Krieger, H. 1944, p. 318 fig. 423 ; Transeau, E. N. 1951, p. 152, pl. 21 ; fig. 11 ; Randhawa, M. S. 1959, p. 291, figs. 245a-c.

Vegetative cells 47-49 μm broad, 80-98 μm long, end-walls plane; each cell with single chloroplast, making 2.5-4 turns; conjugation lateral; fertile cells almost cylindrical; zygospores forming cells usually in pairs, zygospores ellipsoid to oval, 32-35 μm broad, 47-53 μm long; median spore wall smooth, yellow.

Locality—Pond at School line, Port Blair (Coll. no. AN 519, Coll. date 11-10-1979).

Distribution—Punjab (Randhawa, 1938 from Hoshiarpur) ; U. P. (Khan, 1970 from Dehradun ; Bendre et al., 1975 from Meerut ; Pal, 1977 from Saharanpur) ; Maharashtra (Kamat, 1974 from Marathwada).

***Spirogyra crassa* Kuetzing**

Borge, O. 1913, p. 31, fig. 42 ; Transeau, E. N. 1951, p. 193, pl. 32, fig. 6 ; Randhawa, M. S. 1959, p. 343, fig. 345 ; Yamagishi, T. 1966, p. 79, pl. 1, figs. 7-10.

***Spirogyra crassa* var. *minispora* var. nov.**

Text-fig. 1

Cellulae vegetativae 99-105 μm lat., 117-140 μm long., dissepimenta plana; omnis cellula 6-10 chloroplastos qui dimidium anfractus in cellula efficiunt; conjugatio scalariformis, tubi ex ambobus gametangiis emissi, zygosporae ovaes et rotundatae, 65-68 μm lat., 90-96 μm long., membrana sporae media levis, subflava.

Locus typicus—Repertae Haddo Jetty, Port Blair (Coll. no. AN 505, Coll. date 2-12-1978).

Materia in collectionibus Algarum Universitatis Lucknow sub. num. AN 505 deposita.

Vegetative cells 99-105 μm broad, 117-140 μm long, end-walls plane; each cell with 6-10 chloroplasts making half turn; conjugation scalariform, tubes formed by both gametangia; zygospores oval to rounded, 65-68 μm broad, 90-96 μm long; median spore wall smooth, yellowish brown.

Locality—Pond at Haddo Jetty (Coll. no. AN 505, Coll. date 2-12-1978). The material is deposited in the Algal Collections of Lucknow University under No. AN 505.

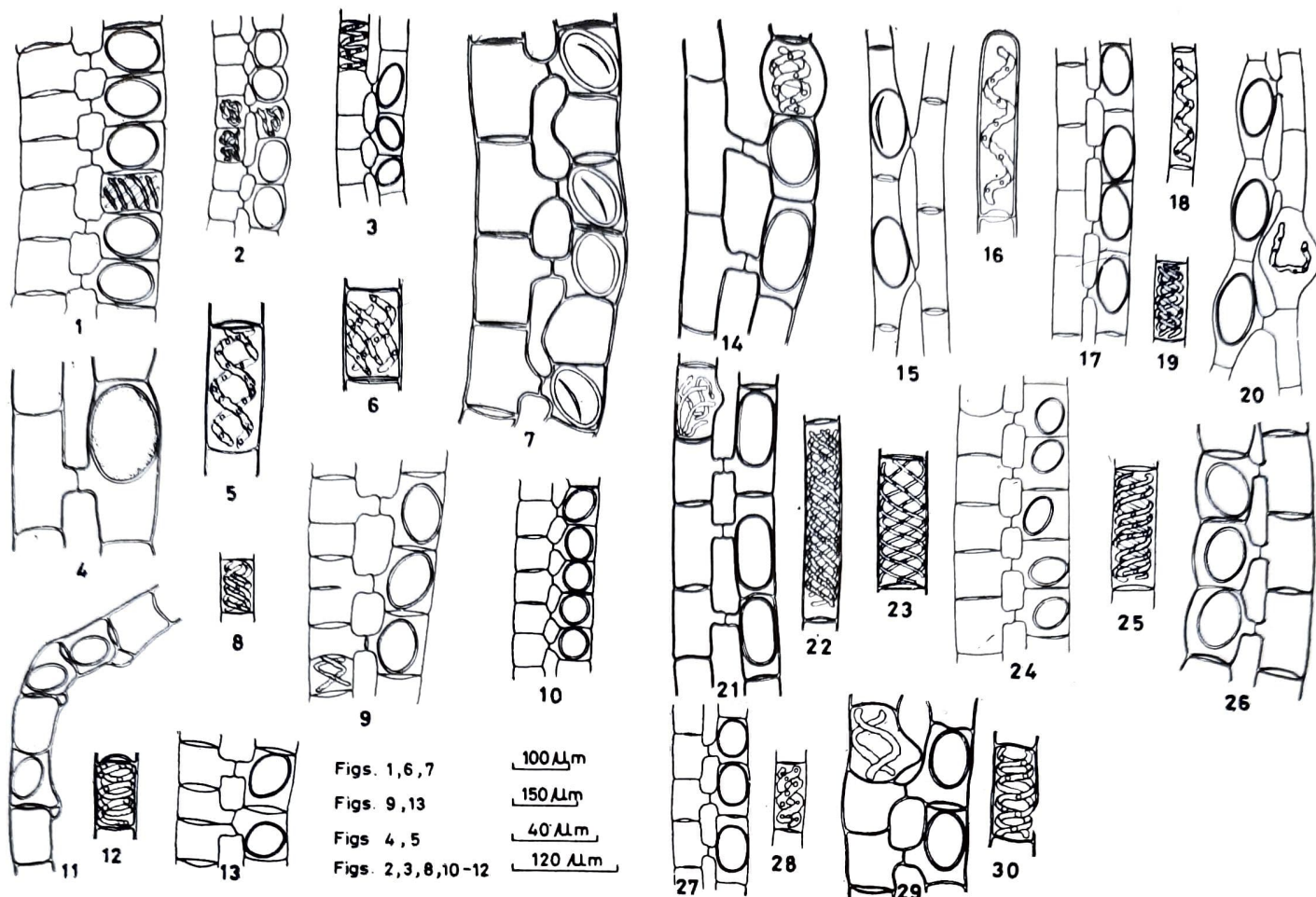
The present variety is distinguished from the type by its narrower filaments and significantly smaller zygospores.

The main species has been recorded from Punjab by RANDHAWA (1959) and from U. P. by SAXENA (1960).

***Spirogyra decimina* (Mueller) Kuetzing**

Text-figs. 4, 5

Czurda, V. 1932, p. 176, fig. 181 as *S. decimina* (Muell.) Czurda ; Kolkwitz, R. & Krieger, H., 1944, p. 321, figs. 427-428; Transeau E. N. 1951, p. 175, pl. 27, fig. 16 ; Randhawa, M. S. 1959, p. 325, figs. 309a-b; Gauthier-Liévre, L. 1965, p. 114, pl. 35, fig. A.



Text-figs. 1-13

Text-figs. 14-30

Text-figs. 1-13—Fig. 1, *Spirogyra crassa* Kuetz. var. *minispora* var. nov., Fig. 2, *S. dubia* Kuetz. ; Fig. 3. *S. porticalis* (Muel.) Clève ; Figs. 4, 5. *S. decimina* (Muel.) Kuetz. ; Figs. 6, 7, *S. elliptica* Jao ; Figs. 8, 10. *S. paradoxa* Rao ; Figs. 9, 13. *S. hymerae* Britton et Smith ; Figs. 11, 12. *S. condensata* (Vaucher) Kuetz.

Text-figs. 14-30—Fig. 14. *Spirogyra exilis* W. et G. S. West; Figs. 15, 16 *S. gracilis* (Hass.) Kuetz. ; Figs. 17, 19, *S. rivularis* (Hass.) Rabenh ; Figs. 18, 20. *S. pratensis* Transeau ; Figs. 21, 22. *S. irregularis* Naeg. ; Figs. 23, 24, *S. neglecta* (Hass.) Kuetz. ; Figs. 25, 26. *S. parvispora* Wood ; Figs. 27, 28. *S. distenta* Transeau ; Figs. 29, 30. *S. bichromatophora* (Randhawa) Transeau. Text-figs. 14 $\times 160$; 15 $\times 235$; 16 $\times 176$; 17, 19, 27-30 $\times 68$; 18, 20 $\times 134$; 21-22 $\times 75$; 23, 24 $\times 96$; 25 $\times 53$.

Vegetative cells 29-31 μm broad, 63-83 μm long, end-walls plane; each cell with 2 chloroplasts making 1-2.5 turns; conjugation scalariform, tubes formed by both gametangial cells; fertile cells cylindrical or slightly enlarged; zygospores broadly ovoid, 37-39 μm broad, 51-54 μm long; median spore wall smooth, yellow at maturity.

Locality—Pond at Astinabad, Port Blair (Coll. no. AN 253, Coll. date 2-12-1978).

Distribution—Jammu & Kashmir (Misra, 1937 as *S. decimina* f. *longispora* Misra from Anantnag; Kant, 1975 from Jammu) ; M. P. (Rao, 1938 as *S. decimina* (Muell). *Czurda* forma Rao from Hoshangabad); U. P. (Rao, 1937, Randhawa, 1959, Lakshminarayana, 1963 and Prasad, 1964-65 from Varanasi; Singh, R. N., 1938 from Gorakhpur ; Chaturvedi, 1975 from Bareilly) ; Kerala (Suxena et al., 1973 from Cranganore).

***Spirogyra distenta* Transeau**

Text-figs. 27, 28

Kolkwitz, R. & Krieger, H. 1944, p. 350, figs. 480-488 ; Randhawa M. S. 1959, p. 324, figs. 306 a-b; Gauthier-Liévre, L. 1965, p. 115, pl. 34, fig. D ; Yamagishi, T. 1966, p. 80, pl. 9, figs. 10-11.

Vegetative cells 45-51.5 μm broad, 65-184 μm long, end-walls plane; each cell with 2 chloroplasts, making 1.5-3 turns; conjugation scalariform, tubes formed by both gametangia; fertile cells cylindrical; sterile cells slightly inflated; zygospores ovoid, 46-48 μm broad, 55-72.5 μm long; median spore wall smooth, yellowish brown at maturity.

Locality—Freshwater ditch at Germanbay, Mayabunder, North Andamans (Coll. no. AN 304, Coll. date 12-11-1978); Pond near Head-quarter, Nancowrie, Nicobar Islands (Coll. no. AN 304; Coll. date 24-11-1978).

Distribution—Not reported.

Spirogyra dubia Kuetzing

Text-fig. 2

Kolkwitz, R. & Krieger, H. 1944, p. 360, fig. 506; Transeau, E. N. 1951, p. 178, pl. 28, fig. 8; Randhawa, M. S., 1959, p. 329, fig. 327; Gauthier-Lièvre, L. 1965, p. 116, pl. 34, fig. C.

Vegetative cells 48-52 μm broad, 155-180 μm long, end-walls plane; each cell with 3 chloroplasts making 2-3 turns; conjugation scalariform, tubes formed by both gametangia, fertile cells inflated; zygospores broadly ellipsoidal to ovoid, 45-49 μm broad, 59-80 μm long; median spore wall thick, smooth, yellowish brown.

Locality—Pond at Batrapur, Port Blair (Coll. no. AN 41, Coll. date 27-1-1978).

Distribution—U. P. (Rao, 1937 as *S. dubia* forma Rao; Lakshminarayana, 1963, Prasad, 1964-65 from Varanasi; Kumar, 1975 from Meerut; Chaturvedi, 1975 from Bareilly; Pandey & Chaturvedi, 1979 from Shahjahanpur); M. P. (Rao, 1938 as *S. dubia* Kuetz. forma Rao from Hoshangabad and *S. dubia* Kuetz. var. *polymorphis* Rao from Jabalpur); Punjab (Rattan, 1968a from Kapurthala and in 1968b as *S. dubia* var. *polymorphis* from Nabha); Manipur (Bharadwaja, 1963); Gujarat (Patel & Asoka Kumar, 1975b from Rajpipla); Maharashtra (Kamat, 1963 from Kolhapur).

Spirogyra elliptica Jao

Text-figs. 6, 7

Transeau, E. N. 1951, p. 172, pl. 27, fig. 6; Randhawa, M. S. 1959, p. 322, fig. 302.

Vegetative cells (97-) 100-116 μm broad, (110-) 130-145 μm long, end-walls plane; each cell with 4 chloroplasts making 3-5 turns; conjugation scalariform, tubes formed by both gametangial cells; fertile cells cylindrical and shortened; zygospores ellipsoid with pointed ends, 82-91 μm broad, 120-135 μm long; median spore wall smooth, yellowish brown.

Locality—Ponds at Beach dera and School Line, Port Blair. (Coll. nos. AN143, AN519; Coll. dates: 29-1-1978, 11-10-1979), Pond at Bakutala Rangat Bay, Middle Andamans (Coll. no. AN 275, Coll. date 10-11-1978).

Distribution—Maharashtra (Randhawa, 1959 from Bombay); Punjab (Rattan, 1964a from Kapurthala); U. P. (Bendre *et al.*, 1975 from Meerut).

Spirogyra exilis W. et G. S. West

Text-fig. 14

West, W. & West, G. S. 1907, p. 186, pl. 10, figs. 11-13; Czurda, V. 1932, p. 189, fig. 198; Transeau, E. N. 1951, p. 174, pl. 27, fig. 13; Randhawa, M. S. 1959, p. 323, fig. 305.

Vegetative cells 24-27.5 μm broad, 58-96 μm long, end-walls plane; each cell with two broad chloroplasts making 1.5-3 turns; conjugation scalariform, tubes formed by both gametangial cells; fertile cells cylindrical or slightly enlarged; sterile cells inflated upto 42 μm ; zygospores oblong with rounded ends, 29.5-32 μm broad, 39-51 μm long; median spore wall smooth, yellow.

Locality—Rainwater puddle at Kadamtala, Rangat Bay, Middle Andamans (Coll. no. AN 268, Coll. date 10-11-1978).

Distribution—U. P. (Bendre *et al.*, 1975 from Meerut).

This species is being described for the first time from Indian territory; earlier it has been enlisted in an account of Algal flora from Meerut by BENDRE *et al.* (1975).

Spirogyra gracilis (Hassall) Kuetzing

Text-figs. 15, 16

Czurda, V. 1932, p. 171, fig. 175 as *S. gracilis* (Kuetz.) Czurda; Kolkvitz, R. & Krieger, H. 1944, p. 328, figs. 441-443; Transeau, E. N. 1951, p. 152, pl. 21, fig. 5; Gauthier-Lièvre, L. 1965, p. 122, pl. 38, figs. b-d; Yamagishi, T. 1966, p. 83, pl. 11, figs. 1-2.

Vegetative cells 16-17.5 μm broad, 59-86 μm long, end-walls plane; each cell with one chloroplast making 2-3.5 turns; conjugation scalariform by tubes from both gametangia; zygospores ellipsoid with rounded ends, 21.5-24.5 μm broad, 42-48.5 μm long; median spore wall yellow, smooth with distinct suture.

Locality—Freshwater drain at Sipighat, Port Blair (Coll. no. AN 518; Coll. date 10-10-1979).

Distribution—U. P. (Khan & Rawat, 1972 from Dehradun; Kamat, 1973 from Nainital; Pal, 1977 from Saharanpur); Maharashtra (Kamat, 1974 from Marathwada).

Spirogyra hymerae Britton *et* Smith

Text-figs. 9, 13

Transeau, E. N. 1951, p. 171, pl. 27, fig. 3; Randhawa, M. S. 1959, p. 321, fig. 300.

Vegetative cells 80-95 μm broad, 72-196 μm long, end-walls plane; each cell with 2 chloroplasts making 0.5 to 1 turns; conjugation scalariform, tubes formed by both gametangial cells; receptive gametange: cylindric or slightly enlarged; zygospores ellipsoid, 62-78 μm broad, 75-115 μm long, median spore wall smooth, yellow.

In this species at a few places two donor gametangia were seen conjugating with one receptive gametangium, thus resulting into triploid zygospores (Text-figs. 9, 13).

Locality—Ditch at Kadamtala, Rangat bay, Middle Andamans (Coll. no. AN 271; Coll. date 10-11-1978).

Distribution—Maharashtra (Randhawa, 1959 from Bombay; Kamat, 1968 from Alibagh); Punjab (Rattan, 1964b from Kapurthala); U. P. (Bendre *et al.*, 1975 from Meerut).

Spirogyra irregularis Naegeli

Text-figs. 21-22

Borge, O. 1913, p. 27, fig. 31; Transeau, E. N. 1951, p. 168, pl. 26, fig. 3; Randhawa M. S. 1959, p. 316, fig. 290; Yamagishi, T. 1966, p. 85, pl. 2, figs. 5-6.

Vegetative cells 39-41.5 μm broad, 128-249 μm long, end-walls plane; each cell with 4 chloroplasts making 2-3 turns, conjugation scalariform by tubes formed by both gametangial cells; receptive gametangia cylindric, zygospores ellipsoid to cylindrical ellipsoid with rounded ends, 37-39.5 μm broad, 82-96 μm long; median spore-wall smooth, light brown.

Andaman specimens exhibit slightly broader vegetative cells, more turns by chloroplasts and slightly larger zygospores.

Locality—Pond at Mile Tilak, Port Blair (Coll. no. AN 568, Coll. date 14-10-1979).

Distribution—Rattan (1963) records this species from Nabha (Punjab), but no description diagrams or measurements are given. Similarly Kamat (1974) names the species as occurring in Marathwada (Maharashtra) but no description or diagrams are given.

Spirogyra neglecta (Hassall) Kuetzing

Text-figs. 23, 24

Borge, O. 1913, p. 29, fig. 36 ; Czurda, V. 1932, p. 190, fig. 200 ; Kolkwitz, R. & Krieger, H. 1944, p. 351, fig. 491 ; Transeau, E. N. 1951, p. 175, pl. 27, figs. 14-15 ; Randhawa, M. S. 1959, p. 324, fig. 308 ; Gautnier-Lièvre, L. 1965, p. 137, pl. 46, figs. A a-a.

Vegetative cells 50-53.5 μm broad, 155-180 μm long, end-walls plane; each cell with 3 chloroplasts making 2.5-3 turns; conjugation scalariform by tubes formed by both gametangial cells; receptive gametangia slightly swollen; zygospores oval to rounded, 48-51 μm broad, 63-74.5 μm long; median spore wall smooth, brown.

Locality—Pond at Mile Tilak, Port Blair (*Coll. no.* : AN568, *Coll. date* 14-10-1979).

Distribution—Himachal Pradesh (Carter, 1926 from Kasauli); U. P. (Rao, 1937 as *S. neglecta* (Hass.) Kuetz. var. *tenuis*, Singh, R. N. 1938 as *S. neglecta* (Hass.) Kuetz. forma Singh & Sarma, 1962-63 from Varanasi; Ahmad, 1967 from Kanpur; Saxena, P. N. from unspecified place); Punjab (Randhawa, 1938 from Hoshiarpur); M. P. (Rao, 1938, main species from Katni and *S. neglecta* (Hass.) Kuetz. forma Rao from Durie); Maharashtra (Kamat, 1963 from Kolhapur; Adhthkar & Kamat, 1978 from Aurangabad); West Bengal (Chatterjee *et al.*, 1980 from Golap Bag).

Spirogyra paradoxa Rao

Text-figs. 8, 10

Rao, C. B. 1937, p. 281, fig. 5E ; Randhawa, M. S. 1959, p. 326, fig. 313; Rattan, R. S. 1967b, p. 98, figs. 15-16.

Vegetative cells 53-54.5 μm broad, 58-67 μm long, end-walls plane; each cell with three chloroplasts making 2-3 turns; conjugation scalariform by tubes formed by both gametangia, receptive gametangia slightly swollen on both sides; zygospores broadly ellipsoidal to spherical, 54-59 μm broad, 60-63.5 μm long; mesospore smooth, light brown.

The Andaman plant exhibits smaller dimensions than recorded by RAO (1937) and RANDHAWA (1959); however, its measurements are closely comparable to that of the specimens recorded from Punjab by RATTAN (1967b). In Punjab alga, formation of tetraploid zygospores have been reported by RATTAN (1967b) which were not seen in plants collected from Andaman Islands.

Locality—Pond at Batrapur ; Port Blair (*Coll. no.* AN 39, *Coll date* 27-1-1978).

Distribution—U. P. (Rao, 1937 from Sarnath ; Khan & Usha, 1971 from Dehradun ; Bendre *et al.*, 1975 from Meerut) ; Punjab (Rattan, 1963 from Nabha, 1967b from Kapurthala).

Spirogyra parvispora Wood

Text-figs. 25, 26

Transeau, E. N. 1951, p. 171, pl. 26, fig. 16 ; Randhawa, M. S. 1959, p. 409, fig. 491.

Vegetative cells 75-76.5 μm broad, 190-330 μm long, end-walls plane; each cell with 4 chloroplasts making 2 turns; conjugation scalariform by both gametangial cells; fertile cells not swollen; zygospores ellipsoid, 42-44 μm broad, 50-65 μm long; mesospore smooth, brown.

In Andaman specimen zygospores are slightly smaller than recorded in the type.

Locality—Pond at School line, Port Blair (*Coll. no.* AN 519, *Coll. date* 11-10-1979).

Distribution—(Kumar, 1975 from Meerut).

Species is being described for the first time from India; earlier, KUMAR (1975) has recorded it in a checklist from Meerut.

Spirogyra porticalis (Mueller) Clève

Text-fig. 3

Borge, O. 1912, p. 25, fig. 27 ; Kolkwitz, R. & Krieger, H. 1944, p. 324, figs. 435-437 ; Transeau, E.N. 1951, p. 160, pl. 23, fig. 9 ; Randhawa, M. S. 1959, p. 306, figs. 272a-c ; Gauthier-Lièvre, L. 1965, p. 144, pl. 49, fig. A.

Vegetative cells 47-50 μm broad, 60-170 μm long, end-walls plane; chloroplast solitary, making 3-4 turns; conjugation scalariform, tubes formed by both gametangia; fertile cells cylindrical or slightly inflated; zygospores ovoid to subglobose, 43-45 μm broad, 63-80 μm long; median spore wall smooth, yellow.

Locality—Pond at Batrapur, Port Blair (Coll. no. AN 39, Coll. date. 27-1-1978).

Distribution—Assam (Carter, 1926 from Asirgarh Hill and Akyab district); Gujarat (Patel & Asoka Kumar, 1975a from Ambaji).

Spirogyra pratensis Transeau

Text-figs. 18, 20

Czurda, V. 1932, p. 169, fig. 173 ; Kolkwitz, R. & Krieger, H. 1944, p. 324, figs. 451-452, 457 ; Transeau, E. N. 1951, p. 156, pl. 1, fig. 7, pl. 22, figs. 14-18 ; Randhawa, M. S. 1959, p. 297 fig. 257 ; Gauthier-Lièvre, L. 1965, p. 144, pl. 50, figs. D-d, d' ; Yamagishi, T. 1966, p. 90, pl. 14, fig. 1

Vegetative cells 16-18.5 μm broad, 60-84 μm long, end-walls plane; each cell with a single chloroplast making 2-3.5 turns; conjugation scalariform by tubes formed by both gametangia; fertile cells fusiform, inflated upto 33 μm in diameter; sterile cells flask-shaped, swollen upto 44 μm ; zygospores ellipsoid, 21-24.5 μm broad, 38-47 μm long; mesospores smooth, light yellow.

Locality—Tank at Shadipur, Port Blair (Coll. no. AN 544, Coll. date 14-10-1979).

Distribution—Punjab (Rattan, 1963 from Nabha) ; U. P. (Lakshminarayana, 1963 from Varanasi).

Spirogyra rivularis (Hassall) Rabenhorst

Text-figs. 17, 19

Transeau, E. N. 1951, p. 169, pl. 26, fig. 8 ; Randhawa, M. S. 1959, p. 317, figs. 292a-C ; Gauthier-Lièvre, L. 1965, p. 151, pl. 53 ; figs. B-b, b' ; Yamagishi, T. 1966 p. 93, pl. 5, figs. 10-11

Vegetative cells 42-45 μm broad, 158-252 μm long, end-walls plane; each cell with 3 chloroplasts making 2-2.5 turns; conjugation scalariform by tubes formed by both gametangial cells; fertile cells cylindrical; zygospores ellipsoid to cylindrical ellipsoid, 39-42 μm broad, 74-81 μm long; median spore wall smooth, yellowish brown.

Locality—Freshwater drain at Sipighat, Port Blair (Coll. no. AN 515, Coll. date 10-10-1979)

Distribution—Maharashtra (Randhawa, 1959 from Bombay) ; Punjab (Rattan, 1964b from Kapurthala, 1967a from Nabha) ; U. P. (Khan & Rawat, 1972 from Dehradun; Bendre, *et al.*, 1975 from Meerut ; Pal, 1977 from Saharanpur) ; Jammu and Kashmir (Kant, 1975 from Jammu) ; Gujarat (Patel & Asoka Kumar, 1975a from Ambaji).

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REFERENCES

- AHMAD, M. R. (1967). Algal flora of some ponds of Kanpur. *Hydrobiologia*, **29**(1-2) : 156-164.
- BENDRE, A. M., KUMAR, S. & SHARMA, S. K. (1975). Zygnemaceae of Meerut. *J. Sci. Res. Gur. Kang. Vis.* **6**(1) : 35-41.
- BHARADAWAJA, Y. (1963). The freshwater algae of Manipur, India I. *Proc. Indian Acad. Sci.*, **57B**(1) : 239-258.
- BORGE, O. (1913). "Zygnemales", Spezieller Teil, In A Pasher's *Die Susswasser flora Deutschlands, Oesterreichs und der Schweiz* **9** : 12-51. Jena.
- BISWAS, K. (1930). Contributions to our knowledge of the fresh-water algae of Manipur, Assam. *J. Bombay nat. Hist. Soc.*, **34** : 189-192.
- BISWAS, K. (1949a). Common fresh and brakish water algal flora of India and Burma. *Rec. bot. Surv. India*, **15**(1) : 1-105.
- BISWAS, K. (1949b). Common fresh and brackish water algal flora of India and Burma. *Rec. bot. Surv. India*, **15**(2) : 169.
- BISWAS, K. & CALADER, C. C. (1936). *Handbook of Common Water and Marsh Plants of India and Burma*. Malaria Bureau, New Delhi.
- CARTER, N. (1926). Fresh water algae from India. *Rec. bot. Surv. India*, **9**(4) : 263-302.
- CHATTERJEE, M., CHOUDHURY, A. & CHATTERJEE, S. P. (1980). Algal flora of the water reservoirs of Golabg, Burdwan, West Bengal. *Phykos*, **19**(1) : 67-69.
- CHATURVEDI, U. K. (1975). A list of green algae from Rohilkhand Division, U.P. India-III. *Phykos*, **14**(1-2) : 49-52.
- CZURDA, V. (1932). "Zygnemales", In A Pascher's *Die Susswasser flora Mitteleuropas, Oesterreichs und der Schweiz*, **9** : 1-232. Jena
- DIXIT, S. C. (1937). The Chlorophyceae of the Bombay Presidency India-I. *Proc. Indian Acad. Sci.*, **5**(1) : 16-25.
- GAUTHEIR-LIÉVRE, L. (1965). "Zygnemaces Africaines." *Beihefte zur Nova Hedwigia*, **20** : 1-120.
- KAMAT, N. D. (1963). The algae of Kolhapur, India. *Hydrobiologia*, **22**(3-4) : 209-305.
- KAMAT, N. D. (1968). Algae of Alibagh, Maharashtra. *J. Bombay nat. Hist. Soc.*, **65**(1) : 88-104.
- KAMAT, N. D. (1973). Algae of Nainital. *J. Bombay nat. Hist. Soc.*, **70**(3) : 582-586.
- KAMAT, N. D. (1974). Algae of Marathwada, Maharashtra. *Phykos*, **13**(1) : 22-32.
- KAMAT, N. D. (1975). Algae of Vidarb, Maharashtra. *J. Bombay nat. Hist. Soc.*, **72**(2) : 450-476.
- KANT, S. (1975). A Note on the occurrence of *Spirogyra* from Jammu. *Phykos*, **14**(1-2) : 13-14.
- KHAN, M. (1970). Algal flora of Dehradun II. Chlorophyceae. *J. Sci. Res. Gur. Kang. Vish.*, **2** : 87-92.
- KHAN, M. & RAWAT, R. S. (1972). Studies on the algal flora of Glatapper Swamp (A preliminary report). *Phykos*, **11**(1-2) : 67-70.
- KHAN, M. & USHA (1971). Algal flora of Dehradun-IV. Zygnemaceae. *J. Sci. Res. Gur. Kang. Vis.*, **3** : 26-28.
- KOLKWITZ, R. & KRIEGER, H. (1944). "Zygnemales", In Rabenhorsts *Kryptogamen-Flora von Deutschland und der Schweiz*, **13** Abt. 2, Leipzig. 499 pp.
- KUMAR, H. (1975). A check list of *Spirogyra* from Meerut. *Phykos*, **14**(1-2) : 11.
- LAKSHMINARAYANA, J. S. S. (1963). Algal flora of Uttar Pradesh-IV. Chlorophyceae : Conjugales, Siphonales and Charales. *Environ. Health*, **5** : 1-5.
- MISRA, J. N. (1937). Zygnemaceae of Kashmir, I. *Proc. Indian Acad. Sci.*, (B). **5**(3) : 110-117.
- PAL, S. (1977). A preliminary list of Zygnemaceae of Saharanpur, U. P., India. *Phykos*, **16**(1-2) : 43-45.
- PANDEY, U. C. & CHATURVEDI, U. K. (1979). Algae of Rohilkhand Division, U. P., India-V. *Phykos*, **18**(1-2) : 37-43.
- PATEL, R. J. & ASOKA KUMAR, C. K. (1975a). Zygnemaceae of Gujarat, India—*Spirogyra* Link. *Phykos*, **14**(1-2) : 53-65.
- PATEL, R. J. & ASOKA KUMAR, C. K. (1975b). Zygnemaceae of Gujarat, India-II. *Sirogonium* Kuetz. and *Spirogyra* Link. *Botanique*, **6**(2-3) : 93-98.

- PRASAD, B. N. (1964-65). On the algal flora of River Varuna in Varanasi District. *J. sci. Res. Banaras Hindu Univ.*, **15**(1) : 142-151.
- RANDHAWA, M. S. (1938). Observation on some Zygnemales from Northern India—Parts 1&2. *Proc. Indian Acad. Sci.*, **8**(3), sec. B : 109-150.
- RANDHAWA, M. S. (1959). *Zygnemaceae*. ICAR Monographs on Algae, New Delhi.
- RAO, C. B. (1937). The Zygnemoideae of the United Provinces, India-I. *J. Indian bot. Soc.*, **16**(5) : 269-288.
- RAO, C. B. (1938). The Zygnemoideae of the Central Provinces, India-I. *J. Indian bot. Soc.*, **17**(5-6) : 341-353.
- RATTAN, R. S. (1963). Some new records of Zygnemaceae from India and Punjab. *Curr. Sci.*, **32** : 567.
- RATTAN, R. S. (1964a). Notes on some Zygnemaceae from Kapurthala (Punjab)-IV. *Res. Bull. (N.S.) Punjab Univ.*, **15**(3-4) : 265-268.
- RATTAN, R. S. (1964b). Some new records of Zygnemaceae from Punjab and India. *J. Indian bot. Soc.*, **43**(3) : 369-373.
- RATTAN, R. S. (1967a). A note on abnormal zygospores in *Spirogyra rivularis* (Hassal.) Rabenhorst. *Res. Bull. (N.S.) Punjab Univ.*, **18**(1-2) : 249-250.
- RATTAN, R. S. (1967b). Notes on some Zygnemataceae from Punjab. *Phykos*, **6**(1-2) : 95-99.
- RATTAN, R. S. (1968a). Note on some Zygnemaceae of Punjab Plains. *Res. Bull. (N.S.) Punjab Univ.*, **19**(1-2) : 253-254.
- RATTAN, R. S. (1968b). Some interesting forms of Zygnemataceae from Punjab (India). *Phykos*, **7**(1-2) : 117-125.
- SARMA, Y. S. R. K. (1962-63). On a collection of Algae from 'Rael Tal' of District Varanasi. *J. Sci. Res. Banaras Hindu Univ.*, **13**(2) : 382-392.
- SARMA, Y. S. R. K. & KHAN, M. (1980). *Algal Taxonomy in India—Today & Tomorrow's Printers & Publishers*, New Delhi.
- SAXENA, P. N. (1980). Algal flora of usar lands in Uttar Pradesh. *Sci. Cult.*, **25**(9) : 542-543.
- SINGH, K. P. (1960). The Chlorophyceae of the Kumaon Hills, U. P., India. *Agra Univ. J. Res.*, **9** : 211-216.
- SINGH, R. N. (1938). The Zygnemoideae of the United Provinces, India-II. *J. Indian bot. Soc.*, **17**(5-6) : 369-384.
- SRINIVASAN, K. (1965). Algalum Species ex India Oriundae. *Bull. bot. Surv. India*, **7**(1-4) : 188-266.
- SUXENA, M. R., VENKATESWARLU, V., SUBBA RAJU, N. & RAO, V. S. (1973). The Algae and Testaceae of Cranganore, Kerala State. *J. Indian bot. Soc.*, **52** : 316-341.
- TRANSEAU, E. N. (1951). *The Zygnemataceae*. Ohio State Univ. Press, Columbus.
- WEST, W. & WEST, G. S. (1907). Freshwater algae from Burma including a few from Bengal and Madras. *Ann. Roy. bot. Gdn. Calcutta*, **6** : 175-260.
- YAMAGISHI, T. (1966). Studies on the genus *Spirogyra* collected in Japan. *The Science Report of the Tokyo Kyoiku Daigaku Soc.*, B, **12**(181) : 73-105.