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Research Paper

ON THE OCCURRENCE OF THE MEMBERS OF NOSTOCALES (CYANOPHYTA) FROM BURDWAN, WEST BENGAL, INDIA WITH A NOTE ON THEIR ECOLOGY

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In the present communication, sixteen members of Nostocales of Cyanophyta have been described. These algae have been collected from a pond and its adjoining rice field areas of Karjona, Burdwan of West Bengal. In this work heterocystous members like *Anabaena anomala* Fritsch, *Aphanizomenon flos-aquae* (Linn.) Ralfs ex Born. et Flah., *Aulosira fertilissima* Ghosh var. *tenuis* Rao C B, *Calothrix weberi* Schmidle, *Gloeotrichia raciborskii* Woloszynska var. *conica* Dixit, and *Rivularia hansgirgi* Schmidle while non-heterocystous members like *Katagnymene pelagica* Lemm., *Lyngbya major* Menegh. ex Gomont, *Lyngbya martensiana* Menegh. ex Gomont, *Lyngbya stagnina* Kützing, *Oscillatoria nigra* Vaucher, *Oscillatoria okeni* Ag. ex Gomont, *Oscillatoria proteus* Skuja, *Oscillatoria subbrevis* Schmidle, *Spirulina gigantea* Schmidle and *Spirulina meneghiniana* Zanard. ex Gomont have been investigated. Of these following three taxa, viz., *Anabaena anomala* Fritsch, *Calothrix weberi* Schmidle, *Rivularia hansgirgi* Schmidle have been reported for the first time from West Bengal. The result shows interesting observations. Most of the heterocystous members like *Anabaena anomala*, *Aphanizomenon flos-aquae* and *Aulosira fertilissima* var. *tenuis* appear early but thrive till December, i.e. they are unable to withstand extreme winter while *Gloeotrichia raciborskii* var. *conica* and *Rivularia weberi* appear late in winter and can withstand winter till onset of summer. Non heterocystous members are however better adapted to environment conditions and can tolerate odds including the summer although unable to survive in extreme dry months in vegetative condition. Occurrence of *Katagnymene pelagica* is rather sporadic.

Keywords: Cyanophyta, Ecology, New records, Nostocales, West Bengal, India

INTRODUCTION

The Nostocales are the filamentous cyanophycean (Cyanophyta) representatives with or without sheath, heterocystous or non-heterocystous, normally unbranched or if branched having false branching. Members of this group are almost ubiquitous; however tropical rice fields and damp soil are excellent habitats for their occurrence. A

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lot of work has been done in India but in spite of it our knowledge is not proper. Desikachary (1959) monographed Cyanophyta in India and its neighboring regions. But Kamat (1963, 1972, 1974), Nair (1967), Tiwari and Pandey (1976), Chadha and Pandey (1979), Pandey (1979), Tiwari (1979), Mahajan and Patel (1989), Tiwari and Chauhan (2006) and Dhingra and Ahluwalia (2007a, 2007b) have reported and worked specifically on Nostocales from various corners of India.

In West Bengal few workers investigated Nostocales, mainly Martens (1870a, 1870b, 1871), Prain (1905), Brühl and Biswas (1922a, 1922b), Biswas (1925, 1926, 1942), Banerjee (1936, 1938), Gupta (1965, 1975), Sinha and Mukherjee (1975), Mukhopadhyay and Chatterjee (1981), Pal and Santra (1982, 1985), Maity and Santra (1985), Gupta and Sen (1987a, 1987b), Sen and Gupta (1987, 1993, 1998), Santra *et al*., (1988), Sen and Naskar (2003), Sen (2005) and Keshri and Chatterjee (2010).

In the present communication, sixteen members of Nostocales have been described. These algae have been collected from a pond and its adjoining rice field areas of Karjona, Burdwan of West Bengal (PLATE-3; Figs. 1 and 2). The place is located about 14 km away from Burdwan on the Burdwan – Katwa bus route near Bhatar. Burdwan district is situated at latitude 22°56' to 23°53' and 86°48' to 88°23' E longitude. The average rainfall is 150 mm and average temperature in summer 30°C and in winter 20°C. Members of Nostocales form the potential source of nitrogen in rice fields (De, 1939) that remain flooded during most of the crop growth cycle. Cyanobacteria have gained special importance in tropical rice cultivation (Venkataraman, 1972) as the rice fields provide ideal conditions for their growth. Many workers have reported the occurrence of different members of Nostocales from rice field soils of the country (Anand, 1990, Anand and Hopper, 1987, Anand and Subramanian, 1994, Choudhary, 2011, Choudhary and Bimal, 2010, Deka and Bordoloi, 1991, Grover and Pandhol, 1975, Kamat and Patel, 1973, Kolte and Goyal ,1985, Mahajan and Patel, 1989, Pandey, 1965, Pandey and Mitra, 1965, Singh *et al*., 1996, 1997a, 1997b, Saikia and Bordoloi, 1994, Sharma and Naik, 1996, Sinha and Mukherjee, 1975, Tiwari 1972, 1975, 1979, Tiwari and Pandey, 1976 and Venkataraman, 1988).

Besides the rice fields, the ponds are also ideal for growth of Nostocales. In an earlier paper the present authors reported the members of Chroococcales in these habitats (Roy *et al*., 2012).

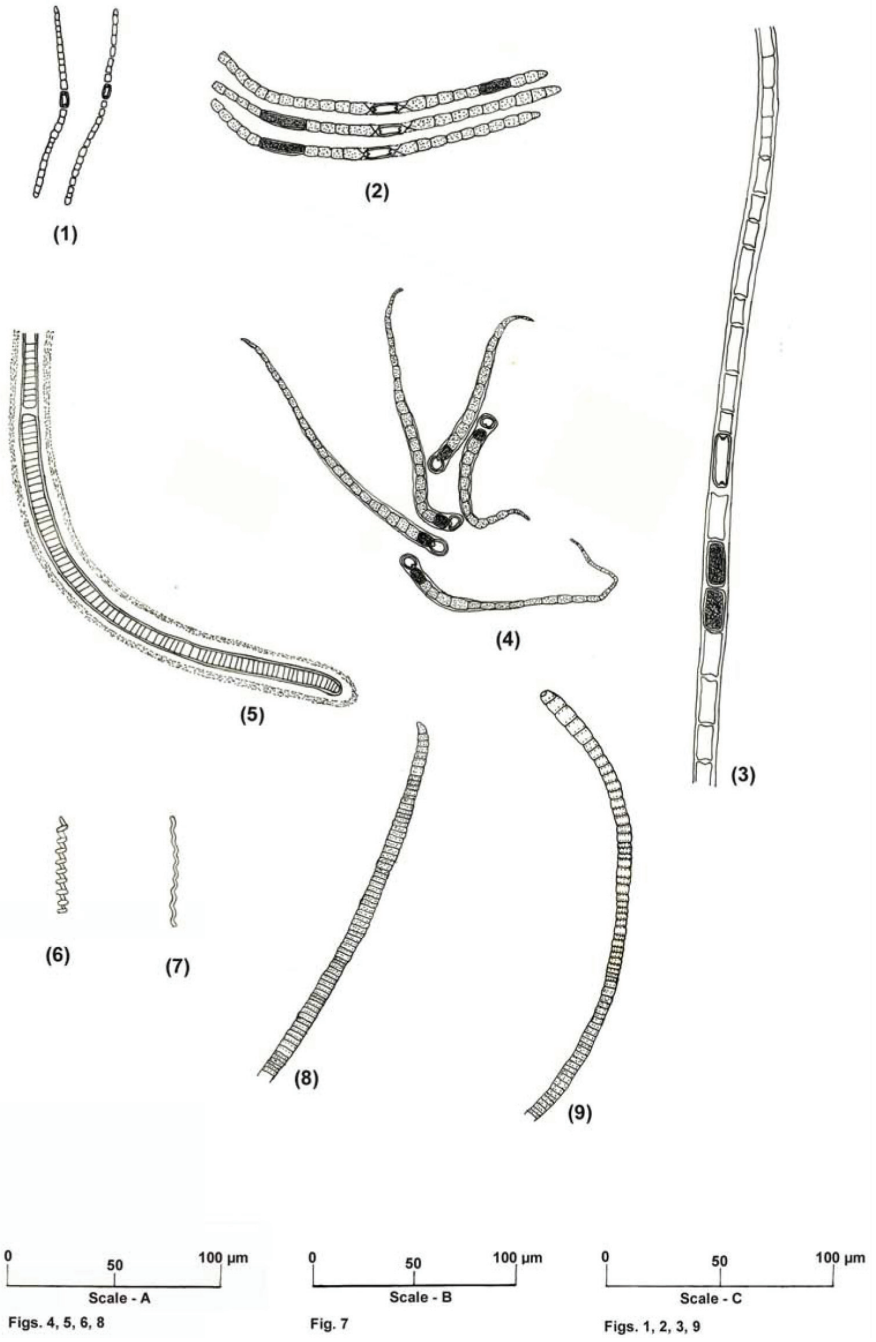
MATERIALS AND METHODS

Algal collections were made with the help of planktonic mesh net and forceps from the above mentioned spot of Burdwan district of West Bengal during September 2006 to March 2007. Collected samples were preserved in FAA (50% Ethanol, Glacial acetic acid, 40% formaldehyde, and water). For preservation on the snails only 5% formalin was used since the glacial acetic acid reacts with the $CaCO_3$ of the snail's shells and may destruct the shell. Algal forms were mounted in glycerine. Taxonomic consideration of algae species has been done on the basis of trichomes/filaments shape, cell dimensions, sheath thickness, shape, size and position of akinetes/heterocysts. pH, temperature and detail

ecological notes were recorded simultaneously. Camera lucida drawings were carried out and algal taxa were identified and systematized according to Desikachary (1959) and Prescott (1962).

PLATE-1

1: *Anabaena anomala;* 2: *Aphanizomenon flos-aquae;* 3: *Aulosira fertilissima* var. *tenuis;* 4: *Calothrix weberi;* 5: *Katagnymene pelagica;* 6: *Spirulina gigantea;* 7: *Spirulina meneghiniana;* 8: *Oscillatoria okeni;* 9: *Oscillatoria proteus*



MORPHO-TAXONOMIC RESULTS

Anabaena anomala Fritsch (Pl. 1, Figure 1)

(Desikachary, 1959, p. 398, Pl. 73, Figure 2)

Thallus thin, gelatinous, blue-green; trichome commonly irregularly aggregated, more or less contorted, moniliform, apical cell subconical, apex obtuse; cells generally 2.5-3.61 µm broad, 5-5.41 µm in length, 1 ½ times as long as broad, barrel-shaped; heterocyst commonly single, intercalary, spherical, 3.5-5.41 µm broad and 7-7.22 µm in length, commonly isolated.

Coll. No.: SR 14 dated 11.11.2006; Shiny, brownish and growing on the aquatic plants, twigs and leaves in the south east corner of the Khan pukur (pH 6.5 and Temp. 27°C); **Coll. No.:** SR17 dated 11.11.2006; Shiny, brownish and growing on the aquatic plants, twigs and leaves in the same locality (pH 6.5 and Temp. 27°C) and **Coll. No.:** SR 23 dated 10.12.2006; thick, shiny layers of algal masses growing on the rice field mud (pH 6.0 and Temp. 24°C).

Distribution in India: Ernakulam, Kerala (Anand and Hopper, 1987); Delhi (Nayak *et al*., 2009); Punjab (Ali and Sandhu ,1972); Maduravoyal, Tamil Nadu (Anand and Subramanian, 1994); Thar, Rajasthan (Bhatnagar *et al*., 2008), Rajasthan (Makandar and Bhatnagar, 2010).

This however appears to be the first report of the taxon from West Bengal.

Aphanizomenon flos-aquae (Linn.) Ralfs. ex Born. et Flah. (Pl. 1, Figure 2)

[Desikachary, 1959, p. 359; Prescott, 1962, p. 528. pl. 122, figs.6-8.]

Trichomes in a bundle, seldom single, straight, parallel, cells 5.41-6.56 µm broad, 7.5-11.25 µm long, up to 10 times as long as broad in the terminal portions, with gas vacuoles, heterocyst nearly cylindrical, 5.41-7.5 µm broad and 11.25-18.05 µm long; spores (gonidia) cylindrical, with rounded ends, 6-7.5 µm broad, 60-80 µm long, epispore smooth and hyaline.

Coll. No.: SR 19 dated 11.11.2006; thick, shiny layers of algal masses growing on the rice field mud (pH 6.5 and Temp. 27°C) and **Coll. No.:** SR 32 dated 20.12.2006; shiny layers growing on the grasses and collected from east side of the pond (pH 4.5 and Temp. 23°C).

Distribution in India: Visakhapatnam, A.P. (Sarojini, 1996); Udaipur, Rajasthan (Pandey *et al*., 1998); Kanpur, UP (Nair, 1967); Delhi (Venkateswarlu and Reddy, 1985); Bihar (Choudhary and Bimal, 2010); Bhagalpur, Bihar (Saha and Wujek, 1989); Agra, Uttar Pradesh (Tiwari and Chauhan, 2008); Hoogly, West Bengal (Roy, 1955).

Aulosira fertilissima Ghose var. *tenuis* Rao C B (Pl. 1, Figure 3)

[Desikachary, 1959, p. 431, pl. 80, fig. 6]

Stratum expanded, grayish blue-green, membranous; trichome straight or a little flexuous, parallel or densely intricate, rarely with very short pseudo branches; cells 8-10. 83 µm broad and 5.5-9.5 µm long, cylindrical when young, later barrel shaped, contents granular; sheath thin, at first gelatinous and hyaline, later firm and brown; heterocysts intercalary, oblong or elliptical, 7.94-8.5 µm broad and 9-12 µm long; spores in series usually alternating with dead cells, generally oblong-elliptical, sometimes angular due to compression, 7.94-11 µm broad and 10-18 µm long; filaments free; trichome slightly tapering at the ends.

PLATE-2

10a, 10b: *Gloeotrichia raciborskii* var. *conica*; 11: *Lyngbya major*; 12: *Lyngbya martensiana*; 13: *Lyngbya stagnina*; 14: *Oscillatoria nigra*; 15: *Oscillatoria subbrevis*; 16a, 16b: *Rivularia hansgirgi*

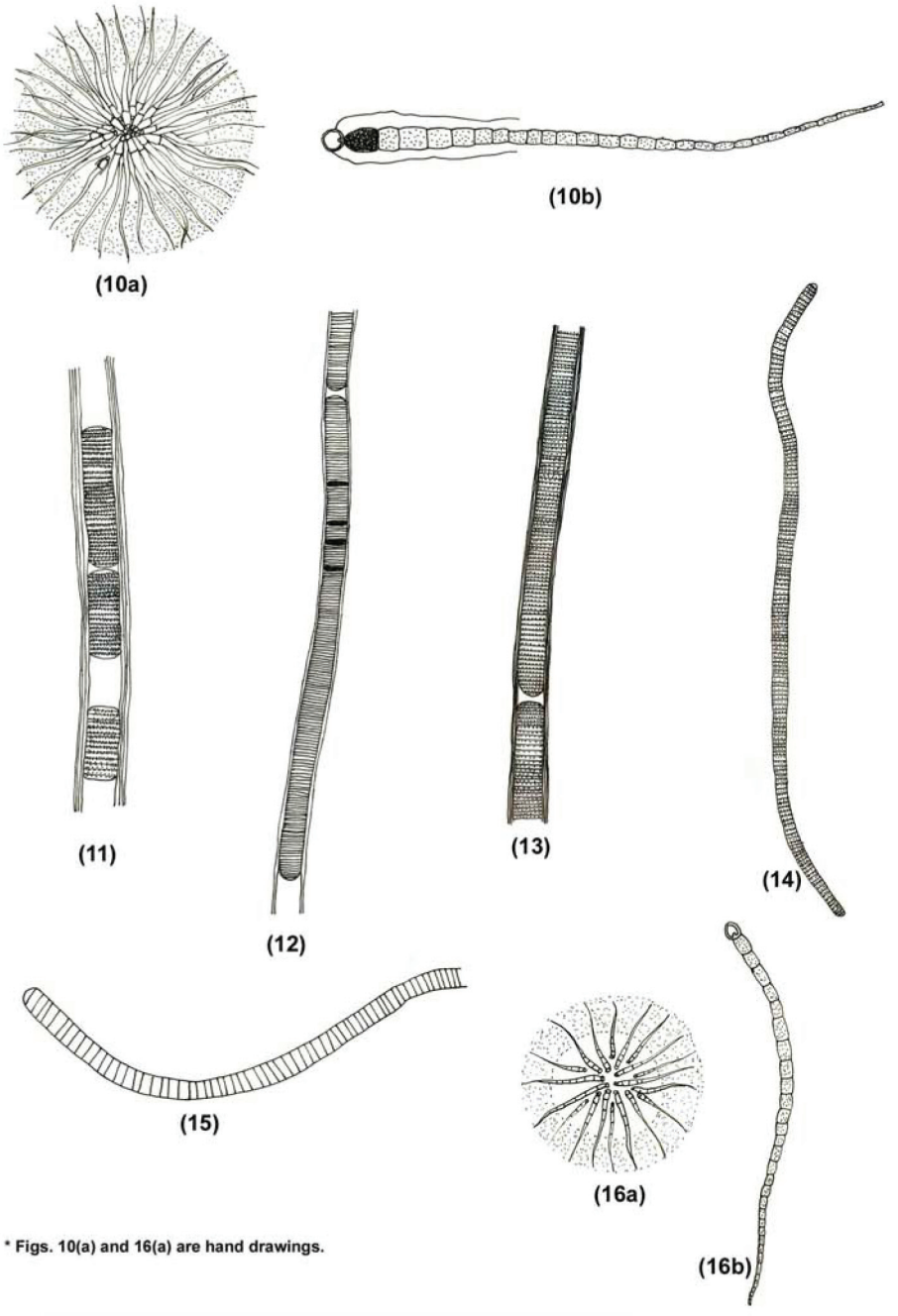
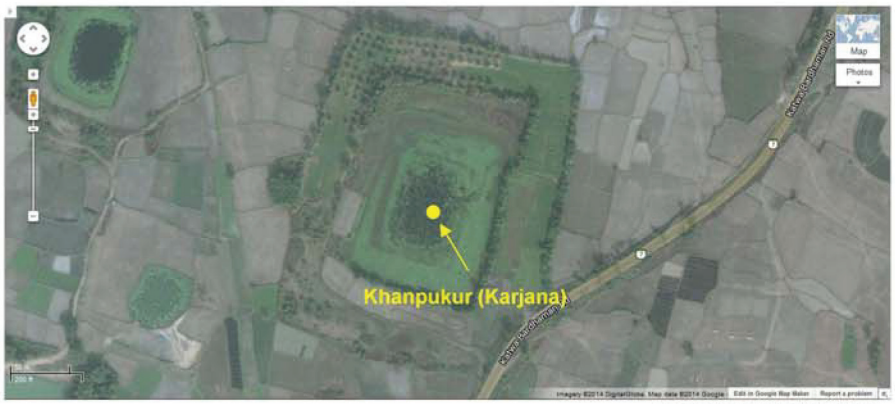


PLATE-3

1: Natural view of Khanpukur and its adjoining rice field areas of Karjona;
2: Google satellite image of Khanpukur and its adjoining rice field areas of Karjona



Coll. No.: SR 10 dated 21.10.2006; Thick, shiny layers of brown coloured algal mass with somewhat hard thick shiny balls are found from paddy field (pH 5.0 and Temp. 22°C) and **Coll. No.:** SR 37 dated 28.12.2006; shiny layer and brown tiny spots present on the submerged aquatic stabs and collected from the east side of the pond (pH 4.5 and Temp. 22°C).

Distribution in India : Mysore, Karnataka (Tiwari 1972); Benares, Uttar Pradesh (Rao 1937); Orissa (Rao, 1938 b); Bihar (Choudhary and Bimal, 2010); Nainital, Uttarakhand (Shukla *et al*.,

2009), Kanpur, Uttar Pradesh (Ahmed, 1967); Bhagalpur, Bihar (Kumar and Choudhary, 2009); Barpeta and Nalbari, Assam (Saikia and Bordoloi, 1994); Mizoram (Singh *et al*., 1996); Tripura (Singh *et al*., 1997); Maduravoyal; Tamil Nadu (Anand and Subramanian, 1994); Jabbalpur, MP (Tiwari, 1972); Karjat, Maharashtra (Tiwari, 1972); Mysore, Karnataka (Tiwari, 1972); Madras, Tamil Nadu ((Tiwari, 1972); West Bengal (De, 1939).

Calothrix weberi Schmidle (Pl. 1, Figure 4)

[Desikachary, 1959, p. 540]

Filaments single or in small bundles, attached, unbranched, very much bent, often irregularly spirally coiled, rarely straight; 7.5-9.4 µm broad at the base, ending in a hair, 2-2.5 µm broad; sheath diffluent, hyaline, thin, close to the trichome; trichomes 3.75-5.6 µm broad; cells cylindrical, 7.5-9.37 µm long, a little longer than broad, blue-green; heterocyst basal , 7.5-11.25 µm in diameter.

Coll. No.: SR 18 dated 11.11.2006; Brownish, tiny spots on submerged aquatic plants, found from the south east corner of the Khan pukur (pH 6.5 and Temp. 27°C) and **Coll. No.:** SR 49 dated 26.01.2007; Shiny layers present on the grasses and somewhat filamentous in appearance and collected from east side of the pond (pH 4.5 and Temp. 22°C).

Distribution in India: Jodhpur, Rajasthan (Vishnoi *et al*. 2008).

This is the first report of the taxon from West Bengal.

Gloeotrichia raciborskii Woloszynska var. *conica* Dixit (Pl. 2, Figures 10a, 10b)

[Desikachary, 1959, p. 563, pl. 117, figs.10-11]

Thallus spherical, soft, broader filaments having breadth 34-40 µm and up to 550 µm long; broader trichomes having breadth 9-10.25 µm, ending in a long hair; heterocyst up to 10-13 µm in diameter; spores (akinete) 10-16.4 µm broad and 24.6-40 µm long; cells at the base of the trichome shorter than broad, higher up as longer than broad, pale blue-green in colour; sheath dull brown in color, sheath dull brown in color, sheath often covers the basal heterocyst, sheath thinning out from base to apex, giving a more or less conical shape.

Coll. No.: SR 07 dated 21.010.2006; Small filaments, growing on the leaf surface, found from the pond (pH 5.0 and Temp. 27°C) and **Coll. No.:** SR 45 dated 13.01.2007; Shiny layers present on the grasses and collected from east side of the pond (pH 5.0 and Temp. 21°C).

Distribution in India: Gonda, Bahraich and Shrawasti, UP (Misra and Srivastava, 2005); Bhagalpur, Bihar (Kumar and Choudhary, 2009); Bihar (Choudhary, 2011); Barpeta, Nalbari and Kamrup, Assam (Saikia and Bordoloi, 1994); Mysore, Karnataka (Tiwari, 1972); Kolli hill, Tamil Nadu (Suresh *et al.,* 2012); Bihar (Choudhary *et al.,* 2011); Maharashtra (Patil *et al.,* 2012).

This is the first report of the taxon from West Bengal.

Katagnymene pelagica Lemm. (Pl. 1, Figure 5)

[Desikachary, 1959, p. 247, pl. 47, figs.6, 10]

Trichomes straight or bent; end cells rounded gelatinous sheath, colorless; cell length 3.75 -4 µm and breadth 10-11.25 µm.

Coll. No.: SR 22 dated 10.12.2006; Brownish, tiny spots on submerged aquatic plants, found from the south east corner of the Khan pukur (pH 6.0 and Temp. 24°C) and **Coll. No.:** SR 31 dated 20.12.2006; Shiny layers present on the grasses

and collected from east side of the pond (pH 4.5 and Temp. 31°C).

Distribution in India: Gopalpara, Assam (Deka and Sarma, 2011); Southern east coast of India (Thajuddin and Subramanian, 1992); North 24-Parganas, WB (Naskar *et al.,* 2008).

Lyngbya major Menegh. ex Gomont (Pl. 2, Figure 11)

[Desikachary, 1959, p. 320, pl. 52, fig.11; Prescott, 1962, p. 502. pl. 112, fig.10]

Filaments long, straight forming dark-green caespitose bundles; sheath thick; colourless, lamellated; cells 16.4-17.4 µm broad, ¼ - 1/5 as long granulated at the septa, not constricted at the cross walls; end cells rounded with a slightly thick end membrane.

Coll. No.: SR19 dated 11.11.2006; thick, shiny layer of algal mass growing on the rice field mud (pH 6.5 and Temp. 27°C) and **Coll. No.:** SR 43 dated 05.01.2007; shiny layers growing on the submerged aquatic stabs and collected from the west side of the pond (pH 5.0 and Temp. 22°C).

Distribution in India: Arunachal Pradesh (Singh *et al.,* 1997a); Orissa (Mohanty, 1982); Tamil Nadu (Suxena, 1983), UP (Rao, 1937, Prasad and Mehrotra, 1980); Karnataka (Somashekar, 1983); West Bengal (Banerjee, 1938, Sinha and Mukherjee, 1975, Mukhopadhyay and Chatterjee, 1981).

Lyngbya martensiana Menegh. ex Gomont (Pl. 2, Figure 12)

[Desikachary, 1959, p. 318, pl. 52, fig.6; Prescott, 1962, p. 502. pl. 112, fig.11]

Thallus caespitose, blue-green, when dried violet; filaments long, more or less flexible; sheath colour less, thick, outside rough; trichome 7.5-8.44 µm broad, not constricted at the cross-walls, cross wall sometimes granulated, apices not attenuated, pale blue-green; cells ¼ times as long as broad, 0.94-1.75 µm in length; end cell rotund, without calyptra.

Coll. No.: SR 24 dated 10.12.2006; Blackish brown coloured, thick aquatic plant parts present in the east corner of the khan pukur (pH 6.0 and Temp. 24°C) and **Coll. No.:** SR 49 dated 26.01.2007; Shiny layers present on the grasses and collected from east side of the pond (pH 4.5 and Temp. 22°C).

Distribution in India: Jodhpur, Rajasthan (Vishnoi and Srivastava, 2006); Raipur, MP (Sharma and Naik, 1996); Maduravoyal, Tamil Nadu (Anand and Subramanian 1994); Sagar, M.P. (Dubey *et al.,* 2011); Ranchi, Jharkhand (Kumar and Sahu, 2012); Katni MP (Tiwari, 1972); Karjat, Maharashtra (Tiwari, 1972); Madras, Tamil Nadu (Tiwari, 1972); Bombay, Maharashtra (Thomas and Gonzalves, 1965); Allahabad, UP (Agarwal and Singh, 2002); Nainital, Uttarakhand (Talpasayi, 1962); Delhi (Suryaprakasa, 1940); Southern east coast of India (Thajuddin and Subramanian, 1992); Chamba, Himachal Pradesh (Singh, 1941); UP (Tiwari *et al.,* 2000); Thanjavur, Tamil Nadu (Madhumathi *et al.,* 2011, Muthukumar *et al.,* 2007); North 24-Parganas, WB (Naskar *et al.,* 2008); WB (Banerjee, 1938, Laloraya and Mitra 1974, Maity and Santra, 1985, Santra *et al.,* 1988).

Lyngbya stagnina Kützing (Pl. 2, Figure 13)

[Desikachary, 1959, p. 317]

Thallus dull-green; filaments flexuous, 14-15 µm broad; sheath colourless or yellowish, lamellae 3; trichome 9.4-10.5 µm broad, not

constricted at the cross-walls; distinctly granulated at the cross-walls; cells 1.87 -2 µm long; end cell broadly rounded, not attenuated.

Coll. No.: SR 24 dated 10.12.2006; Blackish brown colored, thick masses growing on aquatic plant parts and present in the east corner of the khan pukur (pH 6.0 and Temp. 24°C).

Distribution in India: Raipur, MP (Sharma and Naik, 1996); Karjat, Maharashtra (Tiwari, 1972); UP (Rao, 1937); WB (Sinha and Mukherjee, 1975).

Oscillatoria nigra Vaucher (Pl. 2, Figure 14)

[Desikachary, 1959, p. 223, Prescott, 1962, p. 489. pl. 109, fig.18]

Thallus more or less leathery, often free-swimming, olive or dark-brown or blackish, glistering; trichomes straight or more or less bent, grows on water of the paddy field, 6-8.44 µm broad, ends round and truncated; cells up to 1/3 as long as broad, 1.84-2.81 µm in length; septa granulated, slightly constricted.

Coll. No.: SR 01 dated 23.09.2006; Brown, tiny spots on submerged stab of aquatic grasses. Some filaments were found from south east corner (pH 5.5 and Temp. 28°C) and **Coll. No.:** SR 03 dated 23.09.2006; Brown, tiny spots on submerged stab of aquatic grasses. Some filaments were found from south east corner (pH 5.5 and Temp. 28°C).

Distribution in India: Guwahati, Assam (Baruah *et al.,* 2009); UP (Rai *et al.* 2008; Dwivedi *et al.,* 2010).

This is the first report of the taxon from West Bengal.

Oscillatoria okeni Ag. ex Gomont (Pl. 1, Figure 8)

[Desikachary, 1959, p. 231, pl. 38, fig.17]

Thallus dull blue-green; trichome straight, fragile, distinctly constricted at the cross walls, 9-11.25 µm broad, at the ends gradually attenuated, undulating, slightly bent; cells 1/3 as long as broad, 2.7-3.75 µm long, at the ends up to 8 µm long; end cells obtuse or subconical not capitate, without calyptra.

Coll. No.: SR 03 dated 23.09.2006; Brown, tiny spots on submerged stab of aquatic grasses. Some filaments were found from south east corner (pH 5.5 and Temp. 28°C); **Coll. No.:** SR 11 dated 21.10.2006; Filamentous, shiny layers found on the *Oxalis* leaf surface, growing on the rice field (pH 5.0 and Temp. 27°C) and **Coll. No.:** SR 48 dated 13.01.2007; blacking brown coloured, thick aquatic plant parts present in the west side of the Khan pukur (pH 5.0 and Temp. 21°C).

Distribution in India: Gorakhpur, UP (Mishra *et al.* 2008); Agra, UP (Tiwari and Chouhan, 2006); Lucknow, UP (Singh and Suxena, 1969); UP (Rao, 1937, Chaturvedi and Pandey, 1976, Pandey and Chaturvedi, 1979, Chadha and Pandey, 1983); Visakhapatnam, AP (Sarojini, 1996); Arunachal Pradesh (Singh *et al.,* 1997a); Madras, Tamil Nadu (Tiwari, 1972); Delhi (Suryaprakasa, 1940); Orissa (Rao, 1938); Southern east coast of India (Thajuddin and Subramanian, 1992); Gunupur, Orissa (Ghadai *et al.,* 2010); Thanjavur, Tamil Nadu (Deepa *et al.,* 2011); Satna, MP (Singh and Samdariya, 2006); Darbhanga, Bihar (Ranjana *et al.,* 1998); Cochin, Kerala (Vijayakumar *et al.*, 2012); Nainital, Uttarakhand (Shukla *et al.,* 2009); Kolhapur, Maharashtra (Kamat, 1963); Vidarbha, Maharashtra (Kamat, 1975); Punjab (Pandhol and Grover, 1976, Sarma and Kanta, 1978); Orissa (Rao, 1938b, Mohanty, 1982); Kerala (Parukutty,

1940); West Bengal (Sinha and Mukherjee, 1975, Sen Sarkar *et al.,* 2013).

Oscillatoria proteus Skuja (Pl. 1, Figure 9)

[Desikachary, 1959, p. 221, pl. 41, figs.15, 16, 18]

Trichomes amidst other planktonic algae, broader, more or less straight, sometimes curved, apices briefly attenuated and slightly bent or curved, 6.5-7.22 µm broad, well constricted at the cross walls, dissepiments visible, commonly granulated; cells ½ times as long as broad, 3.61-5.41 µm long, contents pale olivaceous or blue-green; apical cell hemispherical to rounded conical.

Coll. No.: SR 42 dated 05.01.2007; Shiny layers and brown tiny spots present on the submerged aquatic stabs and collected from the east side of the pond (pH 5.0 and Temp. 22°C).

Distribution in India: Thane, Maharashtra (Thomas and Gonzalves, 1965); Kashmir Valley, Jammu and Kashmir (Vass, 1980); Allahabad, UP (Tiwari *et al.,* 2001); Agra, UP (Tiwari and Chouhan 2006); Barpeta, Nalbari and Kamrup (Saikia and Bordoloi, 1994); Maharashtra (Nandan and Ahuja, 2010, Nandkar and Marathe, 1983, Barhate and Tarar, 1983); Jaipur, Rajasthan (Gopal *et al.,* 1984, Trivedy, 1982); Chilika lagoon, Orissa (Mohanty and Adhikary, 2013); Satna MP (Singh and Samdariya, 2006); Sagar, MP (Mishra and Purohit, 1979); Karnataka (Somashekar, 1984); Patiala, Punjab (Sarma and Kanta, 1978); West Bengal (Sen and Gupta ,1998, Sinha and Mukherjee, 1975, Pal and Santra, 1985).

Oscillatoria subbrevis Schmidle (Pl. 2, Figure 15)

[Desikachary, 1959, p. 207, pl. 37, fig.2 and pl. 40, fig. 1 ; Prescott, 1962, p. 491. pl. 107, fig.23]

Trichomes single, 7.5-9.38 µm broad, nearly straight, not attenuated at the apices; cells 2-3.75 µm long, not granulated at the cross walls; end-cell rounded, normal calyptra absent.

Coll. No.: SR 48 dated 13.01.2007; blackish brown colored, thick aquatic plant parts present in the west side of the Khan pukur (pH 5.0 and Temp. 21°C).

Distribution in India: Maharashtra (Thomas and Gonzalves, 1965); Ladakh, Jammu and Kashmir (Prasad and Srivastava, 1965); Bombay, Maharashtra (Dixit, 1936); Nainital, UP (Now Uttarakhand) (Singh, 1959b); Mirzapur, UP (Singh, 1959a); Mayurvanj, Orissa (Dey *et al.,* 2010); Nasik, Maharastra (Ansari *et al.,* 2012; Nandan and Ahuja 2010; Thakur and Behere 2008); Papum Pare, Arunachal Pradesh (Mikter *et al.,* 2006); Thiruvarur, Tamil Nadu (Kasthuri *et al.,* 2011); Thanjavur, Tamil Nadu (Muthukumar *et al.,* 2007); Guahati, Assam (Baruah *et al.,* 2009); Kanyakumari, Tamil Nadu (Sugumar *et al.,* 2011; Balasingh, 2010); Kanpur UP (Dubey *et al.,* 2010); Tamil Nadu (Nagasathya and Thajuddin, 2008); Muzaffarnagar UP (Goyal *et al.,* 2008); Chamba, Punjab (Singh, 1941); Andhra Pradesh (Sudhakar and Venkateswarlu, 1989); Mysore, Karnataka (Basavarajappa *et al.,* 2010; Kumar and Hosmani, 2010; Somashekar and Ramaswami, 1984); Cuddalore, Tamil Nadu (Senthilkumar and Sivakumar, 2008; Kannan and Vasantha, 1992; Sankaran 1998; Vetriselvi *et al.* 2011); Allahabad, UP (Gupta and Agrawal, 2008); Bhopal, M.P. (Garg and Garg, 2002), Dindigul, Tamil Nadu (Singh and Balasingh 2011); Dhule, Maharashtra (Patil and Nandan, 2011); Ranchi, Jharkhand (Kumar and Sahu 2012); Kanpur, UP

(Dwivedi 2010); Nagpur, Maharashtra (Tarar and Mazumdar, 1981); Bhagalpur, Bihar (Saha and Wujek, 1989); Satna, M.P. (Singh and Samdariya, 2006); Lucknow, UP (Singh and Saxena, 1969); Manipur (Bharadwaja, 1963); Tamil Nadu (Vijayakumar *et al.,* 2007); Vidarbha, Maharashtra (Cherian 2010a); Nagpur, Maharashtra (Cherian, 2010b); Cochin, Kerala (Senthil *et al.,* 2012); Hyderabad (Reddy and Venkateswarlu, 1985); Gorakhpur, UP (Misra *et al.,* 2008); Bhagalpur, Bihar (Kumar and Choudhary, 2009); Jodhpur, Rajasthan (Vishnoi and Srivastava ,2006); Andhra Pradesh (Reddy and Venkateswarlu, 1992); Jalgaon, Maharashtra (Kumawat and Jawale, 2006); Agra, UP (Tiwari and Chauhan, 2006); Kerala (Shaji and Panikkar, 1994); Maduravoyal, Tamil Nadu (Anand and Subramanian, 1994); Arunachal Pradesh (Singh *et al.,* 1997); Simlipal, Orissa (Dash *et al.,* 2011); West Bengal (Sen and Gupta, 1998); North 24-parganas, West Bengal (Naskar *et al.,* 2008).

Rivularia hansgirgi Schmidle (Pl. 2, Figures 16a, 16b)

[Desikachary, 1959, p. 549 pl. 112, fig.7]

Thallus expanded, nostocoid, flat, gelatinous, thin, solid, blackish brown; trichome long, horizontally expanded, generally intricate and curved; rarely sub parallel, at the end gradually tapering, in the middle 6.15-8.2 µm broad, at the apices 2-3 µm broad; distinctly torulose; sheath thin colourless; cells rectangular or subquadrate, at the base shorter than broad; heterocyst basal, single, hyaline, about 8.2 µm in diameter; having prostrate habit.

Coll. No.: SR 03 dated 23.09.2006; Brown, tiny spots on submerged stab of aquatic grasses. Some filaments were found from south east corner (pH 5.5 and Temp. 28°C) and **Coll. No.:** SR 37 dated 28.12.2006; shiny layer and brown tiny spots present on the submerged aquatic stabs and collected from the east side of the pond (pH 4.5 and Temp. 22°C).

Distribution in India: Nashik, Maharashtra (Nandan and Ahuja 2010); Gorarkhpur, UP (Misra *et al.,* 2006); Bhagalpur, Bihar (Kumar and Choudhary, 2009).

This is the first report of the species from West Bengal.

Spirulina gigantea Schimidle (Pl. 1, Figure 6)

[Desikachary, 1959, p. 197, pl. 36, figs.12, 14,-17]

Trichome 3.5-4.1 µm broad, deep blue –green, regularly spirally coiled, at the end conical attenuated, spirals 11-16 µm broad.

Coll. No.: SR 11 dated 21.10.2006; Filamentous, shiny layers found on the *Oxalis* leaf surface, growing on the rice field (pH 5.0 and Temp. 27°C).

Distribution in India: Udaipur, Rajasthan (Pandey and Pandey, 2002); Mayurbhanj, Orissa (Dey *et al.,* 2010); Shillong, Meghalaya (Rout and Gour, 1994); Palakkad, Kerala (Arulmurugan *et al.,* 2010); Ranchi, Jharkhand (Kumar and Sahu, 2012); Nasik, Maharashtra (Ansari *et al.,* 2012) Gopalpara, Assam (Deka and Sarma 2011); North 24-Parganas, West Bengal (Naskar *et al.,* 2008).

Spirulina meneghiniana Zanard. ex Gomont (Pl. 1, Figure 7)

[Desikachary, 1959, p. 195, pl. 36, fig.8]

Trichome 1.9-2.81 µm broad, flexible, irregularly spirally coiled, bright blue green, forming a thick blue-green thallus; spirals 2.6 - 3.9 µm broad and 2.6-3.9 µm distant from each other.

Coll. No.: SR 11 dated 21.10.2006; Filamentous, shiny layers found on the *Oxalis* leaf surface, growing on the rice field (pH 5.0 and Temp. 27°C) and **Coll. No.:** SR 48 dated 13.01.2007; blackish brown coloured, thick aquatic plant parts with somewhat filamentous in appearance, present in the west side of the Khan pukur (pH 5.0 and Temp. 21°C).

Distribution in India: Thanjavur, Tamil Nadu (Muthukumar *et al.,* 2007); Nasik, Maharashtra (Nandan and Ahuja, 2010; Ansari *et al.,* 2012); Imphal, Manipur (Bharadwaja, 1963); Gujarat (Parikh *et al.,* 2006); Dhule, Maharashtra (Patil and Nandan, 2011); Jalgaon, Maharashtra (Mahajan and Nandan 2007); Uttar Pradesh (Rai *et al.,* 2008); Diamond Harbor, West Bengal (Choudhury and Pal, 2011, Banerjee, 1938); Cuddalore, Tamil Nadu (Anand and Revathi, 1987, Senthilkumar and Sivakumar, 2008, Vetriselvi *et al.,* 2001); Bhagalpur, Bihar (Sinha and Srivastava, 1980, Kumar and Choudhary, 2009); Maduravoyal, Tamil Nadu (Anand and Subramanian, 1994); Maharashtra (Kamat, 1968, 1975; Nandkar and Marathe, 1983); Ahmedabad, Gujarat (1963); Ghaziabad, UP (Pal, 1975); Karnataka (Somashekar, 1983, 1984); North 24-Parganas, West Bengal (Naskar *et al.,* 2008).

DISCUSSION

The selected pond was expanded in an area of approximately 10 bighas (hct.). Plants like *Musa paradisiaca* L., *Cocos nucifera* L., *Mangifera indica* L. and *Psidium guajava* L. etc. shades this pond all around. The pond is full of grasses like *Paspalum vaginatum* Sw., *Cyperus alopecuroides* Rottb., *Cynodon dactylon* (L.) Pers. and many other aquatic plants like *Jussiaea repens* L., *Nymphoides hydrophylla* (Lour.) Kuntze, *Hydrilla verticillata* (L.f.) Royle, *Nymphaea rubra* Roxb. ex Salisb., *Nelumbo nucifera* Gaertn., *Utricularia aurea* Lour., *Vallisneria spiralis* L. etc. Some terrestrial or semiaquatic angiosperms like *Physalis minima* L., *Eclipta alba* (L.) Hassk. and *Commelina benghalensis* L. etc. also grow by the periphery of the pond. This type of vegetation is much suitable for the growth of the algae especially cyanophycean members because the plant twigs and leaves may act as harbour of such algae. The pond is not polluted and has no trace of *Eichhornia crassipes* (Mart.) Solms. So this type of pond is preferably the best suitable site for the blue-green algal growth.

The adjoining rice fields were also selected for the present work because rice field is a suitable and most preferable location for the growth of blue-green algae. The rice fields are of approximately 2 bighas in area. Two different types of paddy crops i.e. 'aus and 'boro' are grown in a year in these rice fields.

The result shows interesting observations (Table 1). Most of the heterocystous members like *Anabaena anomala*, *Aphanizomenon flos-aquae* and *Aulosira fertilissima* var.*tenuis* appear early but thrive till December i.e. they are unable to withstand extreme winter while *Gloeotrichia raciborskii* var. *conica* and *Rivularia weberi* appear late in winter and can withstand winter till onset of summer. Non heterocystous members are however better adapted to environment conditions and can tolerate odds including the summer although unable to survive in extreme dry months in vegetative condition. Occurrence of *Katagnymene pelagica* is rather sporadic.

Table 1: Chart Showing Occurrence of Different Taxa in Different Seasons Within The Study Period

Name of the Algae	2006				2007		
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1. Anabaena anomala	✓	✓	✓	✓			
2. Aphanizomenon flos-aquae	✓	✓	✓	✓	✓		
3. Aulosira fertilissima var. *tenuis*		✓	✓	✓	✓		
4. Calothrix weberi	✓	✓	✓	✓	✓	✓	✓
5. Katagnymene pelagica				✓			
6. Gloeotrichia raciborskii var. *conica*			✓	✓	✓	✓	✓
7. Lyngbya major .	✓	✓	✓	✓	✓	✓	✓
8. Lyngbya martensiana		✓	✓	✓	✓		
9. Lyngbya stagnina	✓	✓	✓	✓	✓	✓	✓
10. Oscillatoria nigra	✓	✓	✓	✓	✓		
11. Oscillatoria okeni		✓	✓	✓	✓	✓	✓
12. Oscillatoria proteus	✓	✓	✓	✓	✓	✓	
13. Oscillatoria subbrevis	✓	✓	✓	✓	✓	✓	✓
14. Spirulina gigantea	✓	✓	✓	✓	✓	✓	✓
15. Spirulina meneghiniana	✓	✓	✓	✓	✓	✓	✓
16. Rivularia weberi					✓	✓	✓

Note: ✓ - available

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REFERENCES

1. Agrawal S C and Singh V (2002), "Viability of dried filaments, survivability and reproduction under water stress and survivability following heat and UV expose in *Lyngbya martensiana, Oscillatoria agardhii, Nostoc calcicola, Hormidium fluitans, Spirogyra* sp. and *Vaucheria germinata*", *Folia Microbiol.*, Vol. 47, No. 1, pp. 61-67.
2. Ahmad M R (1967), "Algal flora of some ponds of Kanpur", *Hydrobiologia,* Vol. 29, No. 1 and 2, pp. 156–164.
3. Ali S and Sandhu G R (1972), "Blue-green of the saline soils of the Punjab", *Oikos,* Vol. 23, No. 2, pp. 268–272.
4. Anand N and Hopper R S S (1987), "Blue-green from rice fields in Kerala state, India', *Hydrobiologia,* Vol. 144, No. 2, pp. 223–232.
5. Anand N and Revathi (1987), "Blue-green

algae from rice fields of Tamil Nadu", *Phykos,* Vol. 26, No. 1, pp. 17-21.

6. Anand N and Subramanian T D (1994), "Distribution of natural populations of blue green algae in a rice field", *Phykos,* Vol. 33, No. 1 and 2, pp. 163–169.

7. Anand N (1990), *Handbook of blue-green algae (of rice fields of South India)*, Bishen Singh Mahendra Pal Singh, Dehradun.

8. Ansari Z, Tambe S S and Nandan S N (2012), "Biodiversity studies of Cyanophyceae in Mausam River of Malegaon city, district: Nasik, state: Maharashtra, *International Journal of Science and Pharma Educational Research,* Vol. 1, No. 2, pp. 69-72.

9. Arulmurugan P, Nagaraj S and Anand N (2010), "Biodiversity of fresh water algae from temple tanks of Kerala", *Recent Research in Science and Technology,* Vol. 2, No. 6, pp. 50-71.

10. Balasingh G S R (2010), "Studies on phytoplankton diversity and seasonal abundance of perennial pond in Kanyakumari – Tamil Nadu, India", *Journal of Basic and Applied Biology,* Vol. 4, No. 3, pp. 188 – 193.

11. Banerjee J C (1936), "Studies on the Myxophyceae of lower Bengal – I", *J. Ind. Bot. Soc.,* Vol. 15, pp. 285–302.

12. Banerjee J C (1938), "Studies on the Myxophyceae of lower Bengal – II", *J. Dept. Sci. Calcutta Univ.,* Vol. 1, pp. 95–109.

13. Barhate V P and Tarar J L (1983), "Algae of Maharashtra 1, Addition to Cyanophyceae of Khandesh", *Phykos*, Vol. 22, No. 1, pp. 67-72.

14. Baruah P P, Kakati B and Ahmed I (2009), "Some fresh water algae of oil refinery effluent drains of Assam, India", *Our Nature,* Vol. 7, pp. 139-145.

15. Basavarajappa S H, Raju N S , Hosmani S P and Niranjana S R (2010), "Algal diversity and physico–chemical parameter in Hadhinaru lake , Mysore , Karnataka state ,India" , *The Bioscan,* Vol. 5, No. 3, pp. 377-382.

16. Bharadwaja Y (1963), "The freshwater algae of Manipur, India –I", *Proceedings: Plant Sciences,* Vol. 57, No. 4, pp. 239-258.

17. Bhatnagar A, Makandar M B, Garg M K and Bhatnagar M (2008), "Community structure and diversity of cyanobacteria and green algae in the soils of Thar Desert (India)", *Journal of Arid Environments,* Vol. 72, No. 2, pp. 73-83.

18. Biswas K (1925), "Road slimes of Calcutta", *J. Dept. Sci. Calcutta Univ.,* Vol. 7, pp. 1-10.

19. Biswas K (1926), "Flora of Salt lakes, Calcutta (West Bengal)", *J. Dept. Sci. Calcutta Univ.,* Vol. 8, pp. 1–47.

20. Biswas K, (1942), "The role of common algal communities of the river Hooghly on the drinking water, Calcutta", *150th Ann. Vol., Roy. Bot. Gdn.,* Pp. 189-206.

21. Brühl and Biswas (1922a), "Algae of Bengal filter beds", *J. Dept. Sci.,* Vol. 4, pp. 1–17.

22. Brühl and Biswas (1922b), "On a new species of *Cylindrospermum* from Bengal – *Cylindrospermum doryphorum*", *Journal and Proceedings, Asiatic society of Bengal (New series),* Vol. 18, No. 1, pp. 577–580.

23. Chadha A and Pandey D C (1979), "Certain

observations on *Scytonema stuposum* (Kuetz.) Born. (Cyanophyta, Nostocales)", *Hydrobiologia,* Vol. 62, No. 2, pp. 105–106.

24. Chadha A and Pandey D C (1983), "Algal flora of Allahabad, Part IV, A general account", *Bibl. Phycologica*, Vol. 66, pp. 141-178.

25. Chaturvedi U K and Pandey U C (1976), "A list of blue-green algae and green algae from Rohilkhand division, UP, India- IV", *Phykos*, Vol. 15, No. 1 and 2, pp. 127-131.

26. Cheriyan K J (2010a), "Effect of Paushamycin on paddy field soil algae of Umrer, Nagpur district, Maharastra", *International journal for Environment Rehabilitation and conservation,* Vol. 1, No. 1, pp. 66-72.

27. Cheriyan K J (2010b), "Rhizosphere algae of paddy in vidabha region of Maharashtra state", *International journal for Environment Rehabilitation and conservation,* Vol. 1, No. 1, pp. 59-65.

28. Choudhary K K (2011), "Occurrence of nitrogen-fixing cyanobacteria during different stages of paddy cultivation", *Bangladesh J. of Plant Taxon.,* Vol. 18, No. 1, pp. 73–76.

29. Choudhary K K and Bimal R (2010), "Distribution of nitrogen-fixing Cyanobacteria (Nostocaceae) during rice cultivation in fertilized and unfertilized paddy fields", *Nordic Journal of Botany,* Vol. 28, No. 1, pp. 100-103.

30. Choudhary K K, Shukla L N and Shukla C P (2011), "Species of Cyanophyta diversity in fly ash affected rice fields along national thermal plant", *Int. J. Algae*, Vol. 13, No. 2, pp. 186-192.

31. Choudhury A K and Pal R (2011), "Variations in seasonal phytoplankton assemblages as a response to environmental changes in the surface waters of a hyposaline coastal station along the Bhagirathi – Hooghly estuary", *Environ. Monit. Assess.,* Vol. 179, No. 1-4, pp. 531-553.

32. Dash P K, Mohapatra P K and Kar M (2011), "Diversity of Cyanobacteria from freshwater bodies of Simlipal biosphere reserve, Orissa, India", *E-planet*, Vol. 9, No. 1, pp. 1–14.

33. De P K (1939), "The role of blue green algae in nitrogen fixing in the rice fields", *Proc. Roy. Soc. London,* Vol. 127, No. B, pp. 121–139.

34. Deepa P, Jeyachandran S, Manoharan C and Vijayakumar S (2011), "Survey of epilithic cyanobacteria on the temple walls of Thanjavur district, Tamil Nadu, India", *World Journal of Science and Technology*, Vol. 1, No. 9, pp. 28-32.

35. Deka M and Bordoloi R P M (1991), "Studies on the blue green algae from rice fields of Assam: A qualitative assessment", *Phykos,* Vol. 30, No. 1 and 2, pp. 173–180.

36. Deka S J and Sarma G C (2011), "Preliminary checklist of Oscillatoriaceae (Cyanophyta), Gopalpara district, Assam, India", *International Journal of Applied Biology and Pharmaceutical Technology,* Vol. 2, No. 4, pp. 430-433.

37. Deka S J and Sarma G C (2011), "Taxonomic studies of Oscillatoriaceae

(Cyanophyta) of Gopalpara District, Assam, India", *Indian Journal of Fundamental and Applied Life Sciences*, Vol. 1, No. 3, pp. 22 – 35.

38. Desikachary, T.V., Cyanophyta, Indian Council of Agricultural Research, New Delhi 1959.

39. Dey H S, Tayung K and Bastia A K (2010), "Occurrence of nitrogen fixing cyanobacteria in local rice fields of Orissa, India", *Ecoprint,* Vol. 17, pp. 77 – 85.

40. Dhingra R and Ahluwalia A S (2007a), "*Cyanostylon* Geitler (Cyanophyta) from Punjab, India", *J. Ind. Bot. Soc.,* Vol. 86, No. 3 and 4, pp. 22–24.

41. Dhingra R and Ahluwalia A S (2007b), "Genus *Phormidium* Kutzing Ex. Gomont (Cyanoprokaryote) from diverse habitats of Punjab", *J. Ind. Bot. Soc.,* Vol. 86, No. 3 & 4, pp. 86–94.

42. Dixit S C (1936), "The Myxophyceae of the Bombay Presidency, India – I", *Proceedings : Plant Sciences,* Vol. 3, No. 1, pp. 93 – 106.

43. Dubey S K, Dubey J, Viswas A J and Tiwari P (2011), "Studies on cyanobacterial biodiversity in paper mill and Pharmaceutical industrial effluents", *British Biotechnology Journal,* Vol. 1, No. 3, pp. 61–67.

44. Dubey S, Dixit A and Boswal M V (2010), "Seasonal distribution of aero-algal allergens in the wet lands of Kanpur", *The Bioscan,* Vol. 3, pp. 673 – 680.

45. Dwivedi S (2010), "Ecological study of micro flora in assessment of pollution level of river water", International Conference on Chemistry and Chemical Engineering (ICCCE), pp. 336-338.

46. Dwivedi S, Srivastava S, Mishra S, Kumar A, Tripathi R D, Rai U N, Dave R, Tripathi P, Chakrabarty D and Trivedi P K (2010), "Characterization of native microalgal strains for their chromium bioaccumulation potential : Phytoplankton response in polluted habitats", *Journal of Hazardous Materials,* Vol. 173, pp. 95-101.

47. Garg J and Garg H K (2002), "Nutrient loading and its consequences in a lake ecosystem", *Tropical Ecology,* Vol. 43, No. 2, pp. 355-358.

48. Ghadai A K, Sahoo S and Raut S (2010), "Agroecological survey of cyanobacterial population in paddy field soils of Gunupur", *International Journal of Agriculture Sciences,* Vol. 2, No. 2, pp. 28-32.

49. Gopal B, Trivedy R K and Goel P K (1984), "Influence of water hyacinth cover on the physicochemical characteristics of water phytoplankton in a reservoir near Jaipur (India)", *Internationale Revue der Gesamten Hydrobiologie und Hydrographie,* Vol. 69, No. 6, pp. 859-865.

50. Goyal A, Tyagi S and Tyagi Y (2008), "Some Oscillatoria Species from rice field soils of district Muzaffarnagar (UP), India', *Plant Archives,* Vol. 8, No.1, pp. 367 – 368.

51. Grover I S and Pandhol R K (1975), "Algal flora of paddy fields of Ludhiana and its adjacent areas", *Phykos,* Vol. 14, pp. 89–97.

52. Gupta D (1965), "Some new records of blue green algae from West Bengal", *Bull. Bot. Soc. Bengal,* Vol. 19, No. 1, pp. 1–2.

53. Gupta D (1975), "Some new records of blue-green algae from West Bengal", *Bull. Bot. Soc. Bengal,* Vol. 29, No. 1, pp. 29–31.

54. Gupta D and Sen C (1987a), "Some Cyanophyceae from Gangetic delta of West Bengal (India) I. Hooghly district: A taxonomic enumeration", *J. Econ. Taxon. Bot.,* Vol. 10, No. 2, pp. 381–386.

55. Gupta D and Sen C (1987b), "Observations on blue green algae of paddy field soils of Gangetic West Bengal I. Burdwan district", *Indian Agric.,* Vol. 31, No. 3, pp. 221–225.

56. Gupta S & Agrawal S C (2008), "Vegetative survival of some wall and soil blue-green algae under stress conditions", *Folia microbiol.,* Vol. 53, No. 4, pp. 343-350.

57. Kamat N D (1963), "The Oscillatoriaceae of Ahmedabad, India", *Bombay Univ. J.,* Vol. 31, pp. 20–27.

58. Kamat N D (1968), "Algae of Alibag, Maharashtra", *J. Bombay Nat. Hist. Soc.*, Vol. 65, No. 1, pp. 88-104.

59. Kamat N D (1972), "Oscillatoriaceae of Mysore state", *Phykos,* Vol. 11, No. 1 & 2, pp. 59–63.

60. Kamat N D (1974), "The Nostocales of the Mysore state", *Phykos,* Vol. 13, No. 1, pp. 33–37.

61. Kamat N D (1975), "Algae of Vidarbh Maharashtra", *J. Bombay Nat. Hist. Soc.,* Vol. 72, No. 2, pp. 450-476.

62. Kamat N D and Patel M Z (1973), "Soil algae of the rice field soils at different depths", *Botanique (India),* Vol. 4, No. 2, pp. 101–106.

63. Kannan L and Vasantha K (1992), "Microphytoplankton of the Pitchavaram mangals, south east coast of India: species composition and population density", *Hydrobiologia,* Vol. 247, No.1-3, pp. 77-86.

64. Kasthuri J, Cholarajan A, Vijayakumar R and Muthukumaran P (2011), "Physico–chemical and microbial analysis of coir Industry effluent", *Asian J. Res. Pharm. Sci.,* Vol. 1, No. 2, pp. 44 – 46.

65. Keshri J P and Chatterjee S (2010), "First record of two Cyanoprokaryotes, *Oscillatoria* (Oscillatoriales) and *Nostoc* (Nostocales), endophytic within the angiosperm *Alternanthera sessilis* (Amaranthaceae) from India", *Algological Studies,* Vol. 135, pp. 83–88.

66. Kolte S O and Goyal S K (1985), "Distributional pattern of blue green algae in rice field soils of Vidarbha region of Maharashtra state", *Phykos,* Vol. 24, pp. 156–162.

67. Kumar A and Sahu R (2012), "Ecological studies of Cyanobacteria in sewage pond of H.E.C. industrial area, Ranchi India", *Bioscience Discovery,* Vol. 3, No. 1, pp. 73–78.

68. Kumar B N and Choudhary S K (2009), "Algal flora of Jagatpur wetland in the middle Ganga flood plain near Bhagalpur, Bihar (India)", *J. Ind. Bot. Soc.,* Vol. 88, No. 3 & 4, pp. 8–11.

69. Kumar N S V and Hosmani S P (2010), "Assessment of algal biodiversity and pollution in santhe (Darga) lake (Mysore district) Karnataka", In: Lake 2010:

Wetlands, Biodiversity and climate change, pp. 1-20.

70. Kumawat D A and Jawale A K (2006), "The genus *Oscillatoria* Vaucher from fish ponds of Jalgaon district, Maharashtra (India)", *J. Ind. Bot. Soc.,* Vol. 85, pp. 97–102.

71. Laloraya V K and Mitra A K (1974), "Studies on the blue-green algae of the paddy fields of India 1", *Nova Hedwigia,* Vol. 47, pp. 227-262.

72. Madhumathi V, Deepa P, Jeyachandran S, Manoharan C and Vijayakumar S (2011), "Antimicrobial activity of Cyanobacteria isolated from fresh water lake", *International Journal of Microbiological Research,* Vol. 2, No. 3, pp. 213-216.

73. Mahajan A D and Patel R J (1989), "*Oscillatoria* Vaucher (Cyanophyceae) from paddy fields of Kaira districts, Gujarat, India", *Indian Bot. Reptr.,* Vol. 8, No. 1, pp. 5–11.

74. Mahajan S R and Nandan S N (2007), in: Sakhare V B (Eds.), *Advances in Aquatic Ecology*, Vol. 1, Daya Publishing House, Delhi, pp. 12-16.

75. Maity H and Santra S C (1985), "Blue green algal flora of 24-Parganas, WB (India)", *Phykos,* Vol. 24, pp. 46–51.

76. Makandar M B and Bhatnagar A (2010), "Morphotypic diversity of microalgae from arid zones of Rajasthan (India)", *J. Algal Biomass Utln.,* Vol. 1, No. 2, pp. 74–92.

77. Martens G V (1870a), "A third list of Bengal algae (determined by G.V. Martens)", *Proc Asiatic Soc. Bengal,* Vol. 39, pp. 9–12.

78. Martens G V (1870b), "A fourth list of Bengal algae (determined by G.V. Martens, communicated by S. Kurz.)", *Proc. Asiatic Soc. Bengal,* Vol. 39, pp. 257–260.

79. Martens G V (1871), "A fifth list of Bengal algae (determined by G V Martens, communicated by S Kurz.). *Proc. Asiatic Soc. Bengal,* Vol. 40, pp. 170–173.

80. Mikter, Soni S and Shukla S P (2006), "Study on algal flora of algal moss association on barks of some selected tree species at rono hills of Papum Pare district in Arunachal Pradesh, India", *Bulletin of Arunachal Forest Research,* Vol. 22, No.1 & 2, pp. 1 – 8.

81. Mishra G P and Purohit J (1979), "Preliminary list of soil algae from Sagar", *Phykos,* Vol. 18, No. 1&2, pp. 63-67.

82. Misra P K and Srivastava A K (2005), "Fresh water Cyanophycean algae from north-eastern Uttar Pradesh, India", *J. Ind. Bot. Soc.,* Vol. 84, pp. 67–75.

83. Misra P K, Mehrotra R K, Shukla M and Prakash J (2008), Genus – *Oscillatoria* Vaucher from district Gorakhpur, Uttar Pradesh", *J. Ind. Bot. Soc.,* Vol. 87, No. 1 & 2, pp. 57–60.

84. Misra P K, Mehrotra R K, Shukla M, Prakash J and Misra P (2006), "Cyanophycean algae from eastern Uttar Pradesh, India", *ECOPRINT,* Vo. 13, pp. 35 – 39.

85. Mohanty D & Adhikary S P (2013), "Assessment of changes in the algal diversity of Chilika lagoon after opening of new mouth to Bay of Bengal", *Journal of Water Resource and Protection,* Vol. 5, pp. 611-623, doi: 10.4236/jwarp:2013.56062.

86. Mohanty R C (1982), "Blue-green algae of Bhubaneswar and its adjoining regions-II", *Phykos,* Vol. 21, pp. 96-98.

87. Mukhopadhyay A and Chatterjee P (1981), "A check of blue-green algae from the paddy fields of 24-Parganas and Hooghly districts of West Bengal – I", *Phykos*, Vol. 20, No. 1 & 2, pp. 81–84.

88. Muthukumar C, Muralitharan G, Vijayakumar R, Panneerselvam A and Thajuddin N (2007), "Cyanobacterial biodiversity from different freshwater ponds of Thanjavur, Tamil Nadu (India)", *Acta Botanica Malacitana,* Vol. 32, pp. 17 – 25.

89. Nagasathya A and Thajuddin N (2008), "Cyano-bacterial diversity in the hypersaline environment of India", *Asian Journal of Plant Sciences,* Vol. 7, No. 5, pp. 473 – 478.

90. Nair G U (1967), "The Nostocaceae of Kanpur – II", *Hydrobiologia,* Vol. 39, No. 1, pp. 145–153.

91. Nandan S N and Ahuja S R (2010), "Study of blue green algal biodiversity of lentic hydrosphere of Haranbari dam of Maharashtra (India)", *Asian J. Exp. Biol. Sci. (Spl.),* pp. 132–135.

92. Nandkar P B and Marathe K V (1983), "Estimation of oxygen produced by dominant algae of six polluted streams", *Journal of the Indian Botanical Society,* Vol. 62, No. 3, pp. 245-252.

93. Naskar N, Naskar K R and Sen C R (2008), "Brakish water Oscillatoriaceae from North 24 – Paraganas, West Bengal, India. *Bangladesh J. Plant Taxon.,* Vol. 15, No. 1, pp. 31 – 38.

94. Nayak S, Prasanna R, Prasanna B M and Sahoo D (2009), "Genotypic and phenotypic diversity of *Anabaena* isolates from diverse rice agro-ecologies of India", *Journal of Basic Microbiology,* Vol. 49, No. 2, pp. 165–177.

95. Pal S (1975), "A check list of algae from Ghaziabad", *Phykos,* Vol. 14, pp. 67.

96. Pal T K and Santra S C (1982), "Contributions to the Cyanophyceae of Murshidabad", *Phykos,* Vol. 21, pp. 150–152.

97. Pal U C and Santra S C (1985), "Algal flora of Midnapore, West Bengal (India) I. Cyanophyceae", *Phykos,* Vol. 24, pp. 12–17.

98. Panday J and Panday U (2002), "Cyanobacterial flora and the physico–chemical environment of six tropical fresh water lakes of Udaipur, India", *Journal of Environmental Science,* Vol. 14, No. 1, pp. 54–62.

99. Pandey D C (1965), "A study of the algae from paddy soils of Ballia and Ghazipur districts of Uttar Pradesh, India. Part II (A) – Taxonomic considerations, Cyanophyceae", *Nova Hedwigia,* Vol. 10, pp. 177–209.

100. Pandey D C and Mitra A K (1965), "Certain new Myxophyceae from the rice field soils of India", *Nova Hedwigia,* Vol. 10, No. 1 & 2, pp. 85-96.

101. Pandey J, Pandey U, Tyagi H R and Rai N (1998), "Algal flora and physico-chemical environment of Fateh sagar lake", *Phykos,* Vol. 37, No. 1 & 2, pp. 29–39.

102. Pandey U C and Chaturvedi U K (1979),

"Algae of Rohilkhand division, UP, India- V", *Phykos,* Vol. 18, No. 1 & 2, pp. 37-43.

103. Pandhol R K and Grover I S (1976), "Algal flora of Ludhiana and its adjoining areas", *Phykos,* Vol. 15, pp. 23-32.

104. Parikh A, Shah and Madahwar (2006), "Cyanobacterial flora from polluted Industrial effluents", *Environmental Monitoring and Assessment,* Vol. 116, No. 1-3, pp. 91-102.

105. Parukutty P R (1940), "The Myxophyceae of Travancore state, India", *Proceedings of the Indian Academy of Sciences-Section B,* Vol. 11, No. 3, pp. 117-124.

106. Patil K J, Mahajan R T and Mahajan S R (2012), "Phytonic diversity of Jalgaon district, Maharashtra (India)", *J. Algal Biomass Utiln.,* Vol. 3, No. 2, pp. 71-102.

107. Patil V P and Nandan S N (2011), "Biodiversity of Cyanophyceae from Amarabati Dam of Dhule district (Maharashtra)", *Journal of Experimental Science,* Vol. 2, No. 3, pp. 33-36.

108. Prain D (1905), "The vegetation of the district Hooghly, Howrah and 24-Parganas", *Rec. Bot. Surv. India,* Vol. 3, pp. 143–339.

109. Prasad B N and Mehrotra R K (1980), "Blue-green algae of paddy fields of Uttar Pradesh", *Phykos,* Vol. 19, No. 1, pp. 121-128.

110. Prasad B N and Srivastava (1965), "Thermal algae from Himalayan hot springs", *Proc. Nat. Inst. Sci.,* Vol. 31 B, No. 1 & 2, pp. 45 – 53.

111. Prescott, G.W., Algae of the Western great Lakes area, 2nd ed, Brown Co. Dubuque, Lowa 1962.

112. Rai U N, Dubey S, Shukla O P, Dwivedi S and Tripathi R D (2008), "Screening and identification of early warning algal species for metal contamination in fresh water bodies polluted from point and non-point sources", *Environ. Monit. Assess.,* Vol. 144, pp. 469-481.

113. Rai U N, Dubey S, Shukla O P, Dwivedi S and Tripathi R D (2008), "Screening and identification of early warming algal species for metal contamination in fresh water bodies polluted from point and non point sources", *Environ. Monit. Assess.*, Vol. 144, pp. 469-481.

114. Ranjana Jha A N, Siddiqui E N (1998), in: Roy A K, Dogra J V V and Varma S K (Eds.), *Phytodiversification and human welfare*, MD Publications Pvt. Ltd., New Delhi 1998.

115. Rao C B (1936), "The Myxophyceae of the United Provinces, India –II", *Proceedings: Plant Sciences, Vol.* 3, No. 2, pp. 165-174.

116. Rao C B (1937), "The Myxophyceae of the Untied Provinces, India – III", *Proc. Indian Acad. Sci.,* Vol. 6, pp. 339–375.

117. Rao C B (1938a), "The Myxophyceae of Madras Presidency, India – I", *J. Indian Bot. Sci.,* Vol. 17, pp. 81–96.

118. Rao C B (1938b), "The Myxophyceae of the Orissa Province, India – I", *Proceedings of the Indian Academy of Sciences-Section B,* Vol. 8, No. 3, pp. 157-170.

119. Reddy P M and Venkateswarlu V (1985), "Ecological studies in the paper mill effluents and their impact on the river Tungabhadra: Heavy metals and algae. *Proc. Indian Acad. Sci. (plant Sci),* Vol. 95, No. 3, pp. 139-146.

120. Reddy P M and Venkateswarlu V (1992), "The impact of paper mill effluents on the algal flora of the river Tungabhadra", *J. Ind. Bot. Soc.,* Vol. 71, pp. 109–114.

121. Rout J and Gour J P (1994), "Composition and dynamics of epilithic algae in a forest stream at Shillong (India)", *Hydrobiologia,* Vol. 291, pp. 61 – 74.

122. Roy H K (1955), "Plankton ecology of the river Hooghly at Palta, West Bengal", *Ecology,* Vol. 36, No. 2, pp. 169-175.

123. Roy S, Mustafa G and Keshri J P (2012), "Observations on some members of Chroococcales (Cyanophyta) from Burdwan, West Bengal, India with a note on their ecology", *J. Econ. Taxon. Bot.,* Vol. 36, No. 2, pp. 292-303.

124. Saha L C and Wujek D E (1989), "Phytoplankton distribution in an oligotrophic pond and a eutrophic pond", *Acta hydrochimica Hydrobiologica,* Vol. 17, No. 4, pp. 407-416.

125. Saikia P and Bordoloi R P M (1994), "Blue-green algal flora from the rice fields of Assam", *Phykos,* Vol. 33, No. 1 & 2, pp. 53–57.

126. Sankaran V (1998), in: Rana B C (Eds.), *Damaged Ecosystem and Restoration,* World Scientific Publishing Co. Pvt. Ltd., Singapore, pp. 281-293.

127. Santra S C, Pal U C, Maity H and Bandyopadhyay G (1988), "Blue green algae in saline habitats of West Bengal, A systematic account", *Biol. Mem.,* Vol. 14, No. 1, pp. 81–108.

128. Sarma T A and Kanta S (1978), "Algal flora of Patiala and its environs", *Phykos,* Vol. 17, No. 1 & 2, pp. 105-111.

129. Sarojini Y (1996), "Seasonal changes in phytoplankton of sewage and receiving harbour waters at Visakhapatnam", *Phykos,* 35 (1 & 2) 171–182.

130. Sen C R and Gupta D (1987), "The genus *Oscillatoria* Vaucher from greater Calcutta", *Bull. Bot. Soc. Bengal,* Vol. 41, pp. 41–45.

131. Sen C R and Gupta D (1993), "Some cyanophyceae from Gangetic delta of West Bengal II Howrah district – A taxonomic enumeration", *J. Econ. Tax. Bot.,* Vol. 17, No. 2, pp. 312–314.

132. Sen C R and Gupta D (1998), "The genus *Oscillatoria* Vaucher from lower gangetic plants of West Bengal", *Phykos,* Vol. 37, No. 1 & 2, pp. 89–93.

133. Sen Sarkar N, Bandyopadhyaya, Dutta S and Das S (2013), "Algae in the assessment of industrial effluents: Case study in Southern Bengal, India", *J. Environ. Pathol. Toxicol. Oncol.,* Vol. 32, No. 2, pp. 101-114.

134. Sen C R (2005), In Keshri J P and Kargupta A N (Eds.), *Glimpses of Indian Phycology,* pp. 205–209.

135. Sen N and Naskar K R (2003), *Algal flora of Sundarban Mangals*, Daya Publishing House, New Delhi.

136. Senthil P, Jeyachandram S, Manoharan C and Vijayakumar S (2012), "Microbial diversity in rubber industry effluent", *I.J.P.B.S.,* Vol. 2, No. 1, pp. 123-131.

137. Senthil Kumar R and Sivakumar K (2008), "Studies on phytoplankton diversity in

response to abiotic factors in Veeranam Lake in the Cuddalore district of Tamil Nadu", *Journal of Environmental Biology,* Vol. 29, No. 5, pp. 747-752.

138. Shaji C and Panikkar M V N (1994), "Cyanophyceae of Kerala, India", *Phykos,* Vol. 33, No. 1 & 2, pp. 105–112.

139. Sharma S and Naik M L (1996), "Rice field cyanobacteria of Pithora block of Raipur district of Madhya Pradesh", *Phykos,* Vol. 35, no. 1 & 2, pp. 139–141.

140. Shukla S K, Misra P K and Shukla C P (2009), "Cyanophycean algae from the foot hills of indo-western Himalaya", *Ecoprint,* Vol. 16, pp. 65-73.

141. Signh N I, Singh N S, Devi G A and Singh S M (1997a), "Blue green algae from rice growing areas of Arunachal Pradesh", *Phykos,* Vol. 36, No. 1 & 2, pp. 21–26.

142. Singh N I, Singh N S, Devi G A and Singh S M (1997b), "Cyanobacterial flora of rice field soils of Tripura", *Phykos,* Vol. 36, No. 1 & 2, pp. 121–126.

143. Singh K P (1959a), "The algal flora of vindhyan formations of the Mirzapur district, UP", *Proceedings: Plant Sciences,* Vol. 49, No. 1, pp. 66 – 73.

144. Singh K P (1959b), "The Myxophyceae of the Kumaon hills, UP, India – I", *Proceedings: Plant Sciences,* Vol. 49, No. 3, pp. 161 – 166.

145. Singh N I, Singh S M, Dorycanta H and Devi G A (1996), "Blue green algae from rice field soils of Mizoram", *Phykos,* Vol. 35, No. 1 & 2, pp. 143–146.

146. Singh R P and Balasingh G S R (2011), "Limnological studies of Kodaikanal lake (Dindugal District), in special reference to phytoplankton for diversity", *Indian journal of Fundamental and Applied Life Sciences*, Vol. 1, No. 3, pp. 112-118.

147. Singh S P (2008-09), "Study of biodiversity of Shankar Bhagawan pond, Muzaffarpur", *Journal of Science and Society for Sustainable Development,* Vol. 1, No. 1-4, pp. 1-5.

148. Singh V P (1941), "On a collection of algae from the Chamba State, Punjab –I", *Proceedings : Plant Sciences,* Vol. 14, No. 3, pp. 250-255.

149. Singh V P and Saxena P N (1969), "Preliminary studies on algal succession in raw and stabilized sewage", *Hydrobiologia,* Vol. 34, No. 3&4, pp. 503-512.

150. Singh R and Samdariya P (2006), in: Kumar A and Singh L K (Eds.), *Advance Ecology, Daya publishing house*, Delhi, pp. 191-197.

151. Sinha B D and Srivastava N K (1980), "Algal flora of Balmikinagar, Bihar", *Phykos,* Vol. 19, pp. 171-174.

152. Sinha J T and Mukherjee D (1975), "On blue-green algae from the paddy fields of Bankura district of West Bengal – I", *Phykos,* Vol. 14, No. 1 & 2, pp. 117–118.

153. Somasekhar L K and Ramaswami S N (1984), "Biological assessment of water pollution : a study of the river Kapila", *International Journal of Environmental Studies,* Vol. 23, No. (3&4), pp. 261-267.

154. Somashekar R K (1983), "Algal flora of river Cauvery, Karnataka 1, Cyanophyceae and Chlorophyceae", *Phykos,* Vol. 22, No. 1, pp. 73-80.

155. Somashekar R K (1984), "Contribution to the algal flora of river Kapila, Karnataka-I, Cyanophyceae & Chlorophyceae", *Phykos,* Vol. 23, No. 1 & 2, pp. 116-124.

156. Somashekar L K and Ramaswami S N (1984), "Biological assessment of water pollution: a case study of the river Kapila", *International Journal of Environmental Studies,* Vol. 23, No. 3 & 4, pp. 261-267.

157. Somashekar R K (1984), *Ecological studies on the two major rivers of Karnataka; ecology and pollution of Indian rivers*, Ashish Publishing House, New Delhi, pp. 39-54.

158. Srivastava P N and Odhwani B R (1992), "Algae from the inland salt pans", *J. Ind. Bot. Soc.,* Vol. 71, pp. 23–27.

159. Sudhakar G and Venkateswarlu V (1989), "Ecological imbalance in the rivers of Andhra Pradesh (India): effect of paper mill effluents on the rivers of Tungabhadra and Godavari", *International Journal of Environmental Studies,* Vol. 34, No. 142, pp. 89-97.

160. Sugumar R, Ramanathan G, Rajarathinam K, Jeevarathinam A, Abirami D and Bhoothapandi M (2011), "Diversity of salt pan marine cyanobacteria from Cape Comarin coast of Tamil Nadu", *Journal of Phytology,* Vol. 3, No. 9, pp. 01 – 04.

161. Suresh A, Praveen Kumar R, Dhanasekaran D and Thajuddin N (2012), "Biodiversity of microalgae in western and eastern ghats, India", *Pakistan Journal of Biological Sciences*, Vol. 15, No. 19, pp. 919-928.

162. Suryaprakasa C (1940), "The Myxophyceae of the Delhi province, India – I", *Proceedings of the Indian Academy of Sciences-Section B",* Vol. 11, No. 3, pp. 125-131.

163. Suxena M R (1983), "Algae from Kodaikanal hill, South India", *Bibliotheca Phycologica,* Vol. 66, pp. 43-99.

164. Talpasayi E R S (1962), "The Myxophyceae of the Kumaon hills, UP, India- II", *Proceedings of the Indian Academy of Sciences-Section B,* Vol. 55, No. 5, pp. 251-255.

165. Tarar J L and Mazumdar G (1981), "Studies on the algae ambazari water treatment plant", *Proceedings: Plant Sciences,* Vol. 90, No. 4, pp. 299-304.

166. Thajuddin N and Subramanian G (1992), "Survey of cyanobacterial flora of the southern east coast of India", *Botanica Marina,* Vol. 35, pp. 305-314.

167. Thajuddin N and Subramanian G (2005), "Cyanobacterial biodiversity and potential applications in biotechnology", *Current Science,* Vol. 89, No. 1, pp. 47–57.

168. Thakur H A and Behere K H (2008), "Study of filamentous algal biodiversity at Gangapur Dam Nasik dist. (M.S.), India", *Proceedings of Taal 2007: The World Lake Conference,* pp. 456-461.

169. Thomas J and Gonzalves E A (1965), "Thermal algae of Western India", *Hydrobiologia,* Vol. 25, No. 3&4, pp. 330 – 340.

170. Tiwari A and Chauhan S V S (2006), "Seasonal variation in some *Oscillatoria* species from polluted ponds of Agra", *J. Ind. Bot. Soc.,* Vol. 85, pp. 110–117.

171. Tiwari A and Chauhan S V S (2008), "Growth and periodicity of cyanobacterial bloom in a polluted pond of Agra city", *J. Environ. Biol.,* Vol. 29, No. 6, pp. 859–862.

172. Tiwari G L (1972), "Study of blue-green algae from paddy fields soils of India", *Hydrobiologia,* Vol. 29, pp. 335–350.

173. Tiwari G L (1975), "A study of the blue green algae from paddy field soils of India. II. Taxonomic consideration of non-heterocystous blue-green algae", *Nova Hedwigia,* Vol. 26, pp. 765–798.

174. Tiwari G L (1979), "A study of the blue-green algae from paddy field of soils of India. Part IV. Taxonomic consideration of Nostocales and Stigonematales", *Nova Hedwigia,* Vol. 63, pp. 133–159.

175. Tiwari G L and Pandey R S (1976), "A study of the blue green algae from paddy field soils of India, Part III, Nostocaceae", *Nova Hedwigia,* Vol. 27, pp. 701-730.

176. Tiwari O N, Dhar D W, Prasanna R, Shukla H M, Singh P K and Tiwari G L (2000), "Growth and nitrogen fixation by non-heterocystous filamentous cyanobacteria of rice fields of Uttar Pradesh, India", *Philippine Journal of Science,* Vol. 129, No. 2, pp. 101-107.

177. Tiwari O N, Prasanna R, Yadav A K, Dhar D W and Singh P K (2001), "Growth potential and biocide tolerance of non-heterocystous filamentous cyanobacterial isolates from rice fields of Uttar Pradesh, India", *Biol. Fertil. Soils,* Vol. 34, pp. 291-295.

178. Trivedy R K (1982), "Some observations on algal flora of Jaipur, Rajasthan", *Phykos,* Vol. 21, No. 1 & 2, pp. 160-163.

179. Vass K K (1980), "On the trophic status and conservation of Kashmir lakes", *Hydrobiologia,* Vol. 68, No. 1, pp. 9-15.

180. Venkataraman G S (1972), *Algal biofertilizers and rice cultivation, Today and Tommorrow's*, New Delhi, pp. 75.

181. Venkataraman, G.S., in: Sen, S.P., Palit, P. (Eds.), Biofertilizers, Potentialities and Problems, Plant Physiology Forum, Calcutta 1988, pp. 79–96.

182. Venkateswarlu V and Reddy P M (1985), "Algae as biomonitors in river ecology", Symposium on biomonitoring, State of Environment New Delhi, India, pp. 183–189.

183. Vetriselvi A, Sivakumar K and Poonguzhali T V (2011), "Seasonal variation of hydrographic parameters and distribution of nutrients in the Perumal lake. Tamil Nadu", *International Journal of Research in Environmental Science and Technology,* Vol. 1, No. 4, pp. 34-42.

184. Vijayakumar S, Thajuddin N and Manoharan C (2007), "Biodiversity of Cyanobacteria in industrial effluents", *Acta Botanica Malacitana,* Vol. 32, pp. 27-34.

185. Vijayakumar M, Deepa P and Vijayakumar S (2012), "Agroecological survey of heterocystous cyanobacteria in Thanjavur district, Tamil Nadu, India", *Advances in applied Science Research,* Vol. 3, No. 1, pp. 530-534.

186. Vishnoi S R and Srivastava P N (2006), "Some interesting algal taxa from alkaline pond of Gura Vishnoiyan, near Jodhpur (Rajasthan, India)", *J. Ind. Bot. Soc.,* Vol. 85, pp. 107–109.

187. Vishnoi S, Srivastava P N and Shekhawat N S (2008), "Removal of colour from textile effluent using cyanobacterial biomass", *Journal of Environmental Science Engineering,* Vol. 50, No. 2, pp. 93–96.