Annals of Plant Sciences
ISSN: 2287-688X
OPEN ACCESS
www.annalsofplantsciences.com

Original Research Article

Freshwater Fungi from Tapi District (Gujarat, India): Stream spora

Borse BD[1], Patil Vandana S[1] and Patil VR[2*]
[1]N.S. Sanstha, Dhule's U.P. Arts & Sci. College, Dahivel–424304, M.S., India.
[2]S.V.S. Naik Arts, Comm. & Sci. College, Raver-425508, M.S., India.

Received: March 29, 2015; **Revised:** April 3, 2015; **Accepted:** April 27, 2015.

Abstract: The present paper deals with eleven species of Mitosporic fungi viz., *Angulospora aquatica* Sv. Nilsson, *Arborispora palma* K. Ando, *Camposporium antennatum* Harkness, *Camposporium pellucidum* (Grove) S. Hughes, *Clavariana aquatica* Nawawi, *Dendrosporium lobatum* Plakidas & Edgerton ex Crane, *Dendrospora erecta* Ingold, *Dicranidion gracile* Matsushima, *Helicomyces colligatus* R.T. Moore, *Helicomyces roseus* Link and *Helicomyces torquatus* Lane and Shearer encountered in foam samples from freshwater habitats. All of them are being recorded for the first time from Gujarat state (India). The data provides information on the distribution of these fungi in India, apart from description and illustrations.

Key words: Fresh water; Tapi District; Mitosporic fungi

Introduction

The fungi from freshwater habitats include a spectacular array of Mitosporic fungi characterized by their magnificent spore types. They play a significant role in the decomposition the organic matter, while bacteria assume a greater role in the decomposition of fine particulate and dissolved organic matter. Hence, knowledge of the geographical distribution pattern of freshwater fungi is important since freshwater habitats are declining at an alarming rate due to human activities and climatic changes. Perturbation of freshwater habitats can lead to loss of species, which may further lead to alteration of ecological processes and ecosystem functions.

The present paper deals with eleven species of Mitosporic fungi viz., *Angulospora aquatica* Sv. Nilsson, *Arborispora palma* K. Ando, *Camposporium antennatum* Harkness, *Camposporium pellucidum* (Grove) S. Hughes, *Clavariana aquatica* Nawawi, *Dendrosporium lobatum* Plakidas & Edgerton ex Crane, *Dendrospora erecta* Ingold, *Dicranidion gracile* Matsushima, *Helicomyces colligatus* R.T. Moore, *Helicomyces roseus* Link and *Helicomyces torquatus* Lane and Shearer. Conidia of these fungi were encountered in freshwater foam samples. All of them are being recorded for the first time from Gujarat (India). The data provides information on the distribution of these fungi in India, apart from description and illustrations.

***Corresponding Author:**
Dr. Patil VR,
S.V.S.Naik A.C.S.College,
Raver-425508,
Maharashtra, India.

Materials and Methods

Foam samples were collected at morning and evening time from study sites. Samples were placed in cleaned wide mouthed plastic bottles and kept for 24 hours to enable the foam to dissolve. It was preserved by adding FAA to yield 5% foam solution. Then samples were brought to laboratory and scanned under low or high power of a microscope by using 15 x Eye-piece for the presence of conidia of freshwater Mitosporic fungi. Permanent voucher slides of fungi were prepared according to the "double cover glass method" described by Volkmann-Kohlmeyer and Kohlmeyer (1996). Identifications of isolated fungi were confirmed with the help of Nilsson (1962), Ando and Kawamoto (1986), Crane, (1972), Descals *et al.,* (1976), Gonczol and Revay (1984), Goos (1985), Hyde *et al.,* (1998), Ingold (1943), Lane and Shearer (1984), Matsushima (1971), Moore (1954), and Shearer (1984). Reports of the fungi studied were confirmed with the help of Bilgrami *et al.,* (1991), Sridhar *et al.,* (1992), Jamaluddin *et al.,* (2004) and relevant literature.

Systematic account:

1) *Angulospora aquatica* Sv. Nilsson
Sv. Bot. Tidskr., **56:** 354 (1962).
Conidia: hyaline, unicellular, 75-100 µm long, 1.5-2 µm broad, tapering to 1 µm broad at the apex, curved or sigmoid, mostly with right and sharp angles and usually in more than one plane.

Habitat: Conidia in foam samples; Ambika River, Tapi distict, 15 Sept. 2012; Leg., B.D. Borse
Distribution in India: Karnataka: On submerged leaves (Rajashekhar and Kaveriappa, 1992); Gujarat: Conidia in foam samples (Present studies).

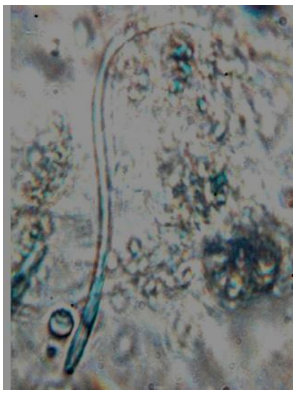

Figure 1: *Angulospora aquatica* Sv. Nilsson,

2) *Arborispora palma* K. Ando
In: Ando and Kawamoto, *Trans. Mycol. Soc. Japan*, **27:** 120 (1986).
Conidia: hyaline, septate, staurosporous composed of a main axis and four primary branches. Main axis is 2-4 septate, 20-30 µm long, 1-2 µm broad in the basal half, and 0.5-1 µm wide at the truncate base. First primary branches develop from the basal or second cell of the main axis at the same level and at a right angle to the main axis, 1-4 septate, 10-20 µm long, 1.5-2 µm wide, constricted to 0.5-2 µm basally. Second primary branches develop from the base of the first primary branches, 0-2 septate, 9-14 µm long, 1-2 µm wide, constricted to 0.5-1 µm at the base.
Habitat: Conidia in foam samples; Ambika River, Tapi distict, 5 Sept. 2013; Leg., V.S. Patil.
Distribution in India: Karnataka: On submerged leaves in tree holes (Karamchand and Sridhar, 2008); Gujarat: Conidia in foam samples (Present studies).

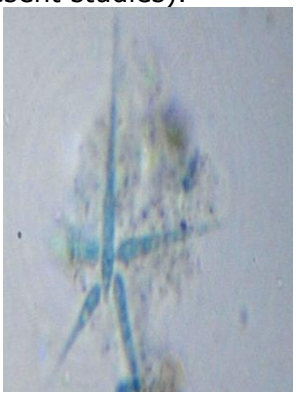

Figure 2: *Arborispora palma* K. Ando

3) *Camposporium antennatum* Harkness
Bull. California Acad. Sci., **1:** 37-38 (1951).
Conidia: smooth, 4-15 -septate, pale brown, end cells paler, 45-75 x 7-9 µm, cylindrical, obconically truncate at the base, apex rounded or slightly attenuate and bears 1-3 divergent, non-septate, hyaline, up to 40 µm long appendages.
Habitat: Conidia in foam samples; Tapi River, Kukurmunda, Tapi distict, 16 Sept. 2012; Leg., V.S. Patil.
Distribution in India: Karnataka: Conidia in foam samples (Rajashekhar and Kaveriappa, 2003); Madhya Pradesh: On submerged leaves (Upadhyaya et al., 2012); Gujarat: Conidia in foam samples (Present studies).

Figure 3: *Camposporium antennatum* Harkness

4) *Clavariana aquatica* Nawawi
In: Descals et al., *Trans. Br. Mycol. Soc*., **67:** 217 (1976).
Conidia: obpyriform to broadly clavate, 5-8 µm wide at the base, broadening to 24-33 µm above; three arms are more or less of the same length develop from its crown, 53-160 µm long, 3-5 µm at its widest point and tapering to 2-2.5 µm at the apex, 0-2-septate; forth arm arises through the detachment scar with same length as the rest of the arms, with age the central body becomes highly vacuolated.
Habitat: Conidia in foam samples; Purna River, Tapi distict, 5 Sept. 2013; Leg., B.D. Borse
Distribution in India: Uttarakhand: Conidia in foam (Mer and Sati, 1989); Karnataka: Conidia in foam and water samples (Sridhar and Kaveriappa, 1982); Gujarat: Conidia in foam samples (Present studies).

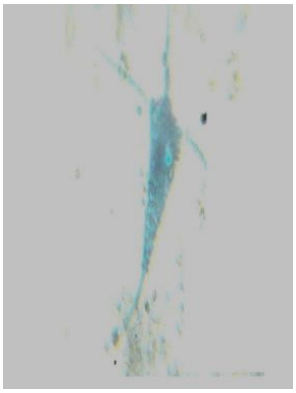

Figure 4: *Clavariana aquatica* Nawawi

5) *Dendrosporium lobatum* Plakidas & Edgerton ex Crane
Mycologia, **28:** 84 (1936).
Crane, *Trans. Br. Mycol. Soc*., **58:** 423 (1972).
Conidia: hyaline, flattened to slightly concave or convex, somewhat triangular, deeply constricted, mostly three-lobed on each side, 7-15 x 4-6 µm, the basal lobe being the largest, 1-septate above the basal lobes, pointed at the apex, the two cells being of unequal length, pedicellate.
Habitat: Conidia in foam samples; Gira River, Tapi distict, 9 Sept. 2013; Leg., V.S. Patil.
Distribution in India: Karnataka: On submerged leaves (Rajashekhar and Kaveriappa, 2003); Madhya Pradesh: On submerged leaves and conidia in foam samples (Upadhyaya et al., 2012); Gujarat: Conidia in foam samples (Present studies).

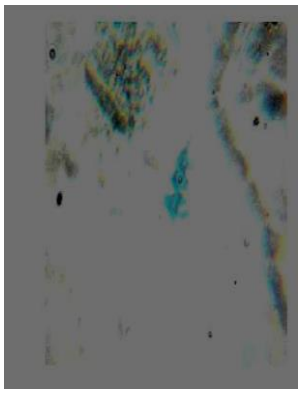

Figure 5: *Dendrosporium lobatum* Plakidas and Edgerton

6) *Dendrospora erecta* Ingold
Trans. Br. Mycol. Soc., **26:** 106 (1943).
Conidia: hyaline, septate, branched; main axis 150-300 µm long, 4-5 µm broad, secondary branches 6-12 in number, 50-180 µm long, 4-5 µm broad, constricted at the base to 2 µm broad, arising (usually in pairs or in whorls of three) from the lower part of the main axis; tertiary branches, which may arise from the lowermost secondary branches, 10-90 µm long, 4-5 µm broad, constricted at the base to 2 µm broad.
Habitat: Conidia in foam samples; Gira River, Tapi distict, 16 Sept. 2012; Leg., V. S. Patil.
Distribution in India: Karnataka: On submerged leaves (Sridhar and Kaveriappa, 1988); Gujarat: Conidia in foam samples (Present studies).

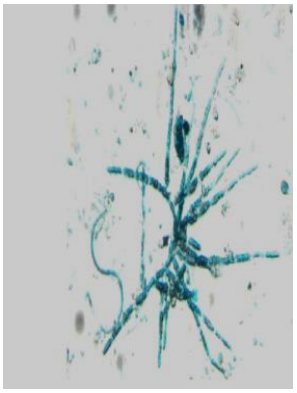

Figure 6: *Dendrospora erecta* Ingold

7) *Dicranidion gracile* Matsushima
Microfungi of the Solomon Islands and Papue-New Guinea, p. 24 (1971).
Conidia: bilobed forked, hyaline, basal part 1-2-septate, obovate, 8-14 µm long, at the base of 01 µm wide, apex in the place of lobes 4-5 µm wide; lobes 16-25 µm long, near the base 3.5-4 µm wide, slightly reduced toward the apex, apex rounded, 3-4-septate, lobes diverging at an angle of 30^0 -45^0, lobes sometimes parallel.
Habitat: Conidia in foam samples; Khapari River, Tapi distict, 8 Sept. 2013; Leg., B.D. Borse
Distribution in India: Karnataka: Conidia in stem flow and through fall (Sridhar and Karamchand, 2009); Gujarat: Conidia in foam samples (Present studies).

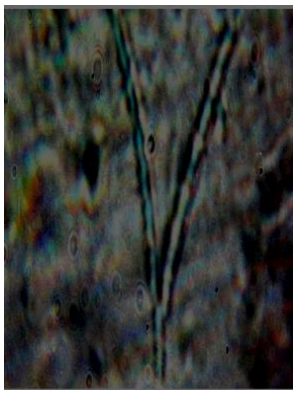

Figure 7: *Dicranidion gracile* Matsushima

8) *Helicomyces colligatus* R.T. Moore
Mycologia, **46:** 89 (1954).
Conidia: loosely coiled 1-2 times, multiseptate, each cell containing one large vacuole or two smaller ones; filament tapering at both ends, the basal end 3.5 µm broad, filament enlarging to 8 µm broad in the middle and becoming slightly less at the distal end, easily broken into segments; diameter of coils 50-60 µm.
Habitat: Conidia in foam samples; Tapi River, Kukurmunda, Tapi distict, 16 Sept. 2012; Leg., V. S. Patil.
Distribution in India: Karnataka: Conidia in foam samples (Ramesh, 2002); Gujarat: Conidia in foam samples (Present studies).

Figure 8: *Helicomyces colligatus* R.T. Moore

9) *Helicomyces roseus* Link
Ges. Naturf. Freunde Berlin Mag. Neuestern Entdeck. Gesammten Naturk., 3: 21(1809).
≡ *Helicomyces albus* Preuss, 1852 (fide Linder, 1929).
≡ *Helicomyces elegans* Morgan, 1892 (fide Linder, 1929).
≡ *Helicomyces clarus*, Morgan, 1892 (fide Linder, 1929).
≡ *Helicomyces fuscopes* Linder, *Ann. Missouri Bot. Gard*., 18: 15-16 (1931).
Conidia: hyaline, frequently with hyaline secondary conidia, 25-60 µm in diam. *Conidial filament*: 4-5 µm in diam, multi-septate, tapering to an enlarged, obliquely flattened basal cell, coiled 2 ¼ -3 times.
Habitat: Conidia in foam samples; Ambika River, Tapi distict, 9 Sept. 2013; Leg., B.D. Borse
Distribution in India: Karnataka: On Submerged leaves and in foam samples (Rajashekhar and Kaveriappa, 2003); Uttarakhand: Conidia in water samples (Arya and Sati, 2012); Gujarat: Conidia in foam samples (Present studies).

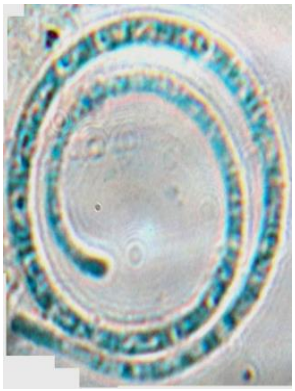

Figure 9: *Helicomyces roseus* Link

10) *Helicomyces torquatus* Lane & Shearer
Mycotaxon. **19:** 291-294 (1984).
Conidia: hyaline, multiseptate, coiled 1.8 to 2.8 times, 75 – 125 µm diam, end cells broadly spathulate, end of basal cell bearing flattened attachment scar. Conidia in water hydrophilic and floating or unwinding to assume a torque-like or sigmoid form, 400 – 500 x 5 – 7 µm.
Habitat: Conidia in foam samples; Purna River, Tapi distict, 8 Sept. 2013; Leg., V.S. Patil.
Distribution in India: Karnataka: Conidia in foam samples (Ramesh, 2002); Gujarat: Conidia in foam samples (Present studies).

Figure 10: *Helicomyces torquatus* Lane and Shearer

11) *Hydrometrospora symmetrica* Gonczol & Revay
Nova Hedwigia, **40:** 199 (1984).
Conodia: hyaline, composed of a more or less fusiform, septate, central body 60-90 x 5-6 µm, central body, to which an H-shaped, branched formation is attached directly or through a short cell. The branches are septate, with pointed ends, diverging more or less from the central body axis, 60-100 x 4-5 µm, and connected by a short cell.
Habitat: Conidia in foam samples; Gira River, Tapi distict, 16 Sept. 2012; Leg., V.S. Patil.

Distribution in India: Karnataka: Conidia in foam samples (Ramesh, 2002); Gujarat: Conidia in foam samples (Present studies).

Figure 11: *Hydrometrospora symmetrica* Gonczol & Revay

Acknowledgments

Authors are thankful to Shri Aravind M. Patil, Chairman, N.S. Sanshta, Dhule's U.P. Arts and Science college, Dahivel, Dist.-Dhule and Dr. R.T. Chaudhary, Principal, S.V.S. Naik Arts, Comm. and Sci. college, Raver-425508, Maharashtra for providing laboratory and library facilities. We are thankful to Dr. Angel Aguirre-Sanchez and authorities of Smithsonian Tropical Research Institute, Washington, DC, USA for providing pdf files of rare research articles on aquatic fungi.

References

1. Ando K, Kawamoto I, 1986a. *Arborispora*, a new genus of hyphomycetes. *Trans. Mycol. Soc. Japan*, 27: 119-128.

2. Arya P, Sati SC, 2012. Estimation of conidial concentration of freshwater Hyphomycetes in two streams flowing at different of Kumaun Himalaya. *J. Ecol, Nat. Environ*., 4: 29-32.

3. Bilgrami KS, Jamaludeen S, Rizwi MA, 1991. "*Fungi of India*", Today and Tomorrow's Printers and Publishers, New Delhi, pp. 798.

4. Crane JL, 1972. Illinois fungi. III. *Dendrosporium lobatum* and *Sporidesmium taxodii* sp. nov. *Trans. Br. Mycol. Soc*., 58: 423-426.

5. Descals E, Nawawi A, Webster J, 1976. Developmental studies in *Actinospora* and three similar aquatic Hyphomycete. *Trans. Br. Mycol. Soc.,* 67: 207-222.

6. Gonczol J, Revay A, 1984. *Hydrometrospora,* a new genus of leaf-litterHyp homycetes from Hungary. *Nova Hedwigia*, 40: 199-205.

7. Goos RD, 1985. A review of the anamorph genus *Helicomyces*. *Mycologia*, 77: 606-618.

8. Hyde KD, Goh TK, Steinke TD 1998. Fungi on submerged wood in the Palmiet River, South Africa. *S. Afr. J. Bot*., 64: 151-162.

9. Ingold CT, 1943. Further observations on aquatic Hyphomycetes on decaying leaves. *Trans. Br. Mycol. Soc*., 26: 93-104.

10. Jamaludeen S, Goswami MG, Ojha BM, 2004. *"Fungi of India* (1989-2001*)",* Scientific Publishers (India), Jodhpur, pp. 308.

11. Karamchand KS, Sridhar KR, 2008. Water-borne conidial fungi inhabiting tree holes of the West coast and Western Ghats of India. *Czech Mycol.,* 60: 63-74.

12. Lane LC, Shearer CA, 1984. *Helicomyces torquatus*, a new Hyphomycete from Panama. *Mycotaxon*, 19: 291-297.

13. Matsushima T, 1971. Microfungi of the Solomon Islands and Papua-New Guinea. Published by author, Kobe, pp. 78.

14. Mer GS, Sati SC, 1989. Seasonal fluctuation in species composition of aquatic Hyphomycetous flora in a temperate fresh water streams of Central Himalaya, India. *Int. Rev. Ges. Hydrobiol*., 74: 433-437.

15. Moore RT, 1954. Three new species of Helicosporae. *Mycologia,* 46: 89-92.

16. Nilsson S, 1962. Second note on Swedish freshwater hyphomycetes. *Bot. Not.,* 115: 73-86.

17. Plakidas AG, Edgerton CW, 1936. A new Imperfect fungus. *Mycologia*, 28: 82-84.

18. Rajashekhar M, Kaveriappa KM, 1992. New records of water-borne Hyphomycetes from India. *Indian Phytopath*., 45: 138.

19. Rajashekhar M, Kaveriappa KM, 2003. Diversity of aquatic Hyphomycetes in the aquatic ecosystems of the Western Ghats of India. *Hydrobiologia*, 501: 167-177.

20. Ramesh Ch, 2002. Seasonal occurrence of water borne fungi in different streams of Uttar Kannada region, Karnataka stare, India. *Kavaka,* 30: 31-52.

21. Sridhar KR, Karamchand KS, 2009. Diversity of ware-borne fungi in stemflow and throughfall of tree canopies in India. *Sydowia*, 61: 347-364.

22. Sridhar KR, Kaveriappa KM, 1982. Aquatic fungi of the Western Ghat forest in Karnataka. *Indian Phytopath*., 35: 293-296.

23. Sridhar KR, Kaveriappa KM, 1988. Colonization of leaf litter by Aquatic Hyphomycetes in a Western Ghat stream. *Proc. Ind. Nat. Sci. Acad.,* B 54: 199-200.

24. Sridhar KR, Chandrashekar KR, Kaveriappa, KM, 1992. Research on the Indian Subcontinent. In: The Ecology of Aquatic. Hyphomycetes (ed. Balocher, F.), Spinger-Verlag, Berlin, pp. 182-211.

25. Upadhyaya A, Singh J, Tiwari J, Gupta S, 2012. Biodiversity of water borne conidial fungi in Narmada River. *Intern. Multidisci. Res. Journal*, 2: 20-22.

26. Volkmann-Kohlmeyer B, Kohlmeyer J, 1996. How to prepare truly permanent microscopic slides. *Mycologist,* 10: 107-108.

Source of support: Nil
Conflict of interest: None Declared