

Aquatic Fungi from Buldhana District (M.S., India) – IV: Ascomycetes

Borse B. D.* , Patil V. R.¹

*N.S. Sanstha, Dhule's U.P. Arts & Sci. College, Dahivel-424304, M.S., India
1. S.V.S. Naik Arts, Comm. & Sci. College, Raver-425508, M.S., India

Abstract: The present article deals with five species of the freshwater Ascomycetes viz., *Aniptodera inflatiascigera* K.M. Tsui, K.D. Hyde and I.J. Hodgkiss; *Ascocacculus heterogattulata* (S.W. Wong, K.D. Hyde and E.B.G. Jones) J. Campb., J.L. Anderson and Shearer; *Neomassariosphaeria typhicola* (P. Karst.) Yin, Zhang, F. Fourn. and K.D. Hyde; *Savoryella verrucosa* Minoura and T. Muroi; and *Zopfiella karachiensis* (S.L. Ahmed and Asad) Guarro which were isolated from submerged wood in freshwater habitats. *A. inflatiascigera* is being recorded for the first time from India. The remaining four Ascomycetes were additions to the fungi of Maharashtra state (India). The data provides information on the distribution of these fungi in India apart from description and illustrations.

Keywords: Ascomycetes Freshwater, submerged wood, Penganga River, Buldhana

1. Introduction

Freshwater Ascomycetes are defined as Ascomycetous fungi which have been recorded in freshwater habitats and which complete part, or the whole of their lifecycle within freshwater environments (Shearer, 1993). These fungi inhabit submerged woody material in lentic (e.g. lakes, ponds etc.) and lotic (e.g. rivers, streams etc.) habitats (Wong et al., 1998a), playing important roles in recycling of organic matter in the freshwater ecosystems. Freshwater Ascomycetes comprise a diverse taxonomic assemblage of about 622 species (Cai et al., 2014; Shearer et al., 2014).

These fungi are mostly saprobic on submerged woody and herbaceous debris and are important in aquatic food webs as decomposers and as a food source to invertebrate grazers (Simonis et al., 2008). Although in the early Ascomycete taxonomic literature some species were reported and/or described from plants in or near aquatic habitats, little was noted about whether the fungi were on aerial or submerged parts of their hosts/substrates. Shearer et al. (2009) considered freshwater Ascomycetes as only those species that occur on submerged substrates and Ascomycetes encountered on aerial parts of aquatic plants are considered terrestrial.

Previous work on freshwater Ascomycetes from India was reviewed by Borse et al. (2014). During an ongoing investigation of freshwater fungi on submerged wood in lotic and lentic habitats from Buldhana district of Maharashtra, we isolated one previously unreported species of the genus *Aniptodera* namely *A. inflatiascigera* from India. The remaining four species are being collected for the first time from freshwater habitats in Maharashtra which are described and illustrated in the present paper.

2. Materials and Methods

Samples of submerged wood supporting freshwater Ascomycetous fungi were collected randomly during 2012-13 from different lentic and lotic habitats from Buldhana district (Maharashtra state). The samples were

placed in plastic bags and sealed well in order to avoid moisture loss. On returning to the laboratory, samples with debris and fouling organisms were washed thoroughly with running tap water. Surface fouling organisms were scrapped off, following rinsing in tap water. The fresh samples were examined using a stereomicroscope for fungal growth. After initial observations, samples were incubated in plastic boxes and kept moist by spraying with distilled water and periodically examined for presence of fungal growth. Permanent voucher slides of fungi were prepared according to the method 'double cover glass' described by Volkmann-Kohlmeyer and Kohlmeyer (1996). Identifications of isolated taxa were confirmed with the help of Tsui et al. (1997), Wong et al. (1998b), Kohlmeyer and Kohlmeyer (1979), Minoura and Muroi (1978) and Udaiyan (1989). Reports of fungi studied were confirmed with the help of Bilgrami et al. (1991), Jamaluddin et al. (2004) and Borse et al. (2014).

3. Taxonomic Account

1) *Aniptodera inflatiascigera* K.M. Tsui, K.D. Hyde & I.J. Hodgkiss
Sydowia, **49**: 187-192 (1997).

Ascomata: 200-300 µm in diam, globose, subglobose or pyriform, partly immersed or superficial, hyaline to greyish brown, partly membranaceous, ostiolate, periphysate, neck yellowish. *Necks*: 190-220 µm long, 60-70 µm in diam, cylindrical, periphysate, hyaline. *Peridium*: composed of an outer layer of *textura angularis* and inner layer of compressed cells. *Catenophyses*: present. *Asci*: 150-200 x 15-35 µm, 8-spored, clavate, becoming ball-shaped or swollen, pedicellate, thin-walled, apically rounded, with apical thickening which has a central pore, and cytoplasm retraction below the ascus apex, somewhat persistent. *Ascospores*: 35-45 x 15-20 µm, hyaline, ellipsoidal, bicelled, not constricted at the septum, relatively thick-walled, with or without polar appendages; delicate, released from the pores at the ascospore tips.

Habitat: On submerged wood, Penganga River (Chikhli), 2 Oct..2011leg. V.R. Patil

Remarks: The genus is represented by 11 freshwater (Hyde et al, 1999) and 8 marine species (Jones et al., 2009). The general characteristics of the specimen from Buldhana district are in agreement with those reported for *Aniptodera inflatiascigera* (Tsui et al., 1997). Therefore, it is assigned to that species. It is being reported for the first time from India.

2) *Ascosacculus heterogattulata* (S.W. Wong, K.D. Hyde & E.B.G. Jones) J. Campb., J.L. Anderson & Shearer *Mycologia*, **95**: 545 (2003).

≡ *Halosarpheia heterogattulata* S.W. Wong, K.D. Hyde & E.B.G. Jones, *Can. J. Bot.*, **76**: 1858 (1998b).

Ascomata: 120-165 µm in diam., globose to subglobose, immersed or superficial, black, membranous, ostiolate, papillate, periphysate. **Necks:** long **Peridium:** 20-25 µm thick composed of several layers of brown elongate cells. **Catenophyses:** present. **Asci:** 8-spored, deliquescing early. **Ascospores:** 27-35 x 10-17 µm, ellipsoidal, hyaline, 1-septate, equally two-celled, apical cell with one or two large lipid gattule (s), basal cell with numerous small gattules, with bipolar, hamate, and highly coiled filamentous appendages that unferl in water to form long strands.

Habitat: On submerged wood, Penganga River (Chikhli), 2 Oct..2011leg. V.R. Patil

Distribution:- *Karnataka:* On submerged wood (Sridhar et al., 2011); *Maharashtra:* present study.

Remarks: The genus *Ascosacculus* is represented by two species in freshwater habitats (Campbell et al., 2003). The present specimen was identified based mostly on Ascomata morphology, habitat as well as ascospores morphology, and to a lesser extent on ascus morphology because the majority of ascomata were mature contained only mature ascospores as asci are deliquescent in most of the aquatic ascomycetes. One of the most striking feature of *A. heterogattulata* is the ascospores with apical cell contains one or two large lipid gattule(s) and basal cell with numerous small gattules. The species described and illustrated here fits the description of ascomata and ascospores of *Ascosacculus heterogattulata* provided by Wong et al. (1998b). Therefore, it is assigned to that species. It is being recorded for the first time from Maharashtra state.

3) *Neomassariosphaeria typhicola* (P. Karst.) Yin, Zhang, F. Fourn. & K.D. Hyde

In: Zhang et al., *Studies Mycology*, **64**: 96 (2009a).

Basionym: *Leptosphaeria typhicola* P. Karst., 1873. *Bidrag Kannedom Finlands nature Folk.*, **23**: 100.

≡ *Leptosphaeria baldingerae* Fautrey & F. Lamb., *Revue Mycol., Toulouse*, **19**: 53 (1897).

≡ *Leptosphaeria cladii* Cruchet, *Bull. Soc., Vaud. Sci. Nat.*, **55**: 161 (1923).

≡ *Phaeosphaeria baldingerae* (Fautrey & F. Lamb.) Hedjar., *Sydowia*, **22**: 87 (1969).

≡ *Phaeosphaeria typhicola* (P. Karst.) Hedjar., 1969. *Sydowia*, **22**: 86.

≡ *Massariosphaeria typhicola* (P. Karst.) Leuchtm., 1984. *Sydowia*, **37**: 168.

≡ *Chaetomastia typhicola* (P. Karst.) M.E. Barr, 1989. *Mycotaxon*, **34**: 514.

Ascomata: 180-220 µm high, 200-430 µm diam., subglobose to depressed-ellipsoidal, immersed or erumpent, ostiolate, epapillate or with short papillae perforating the epidermis, subcoriaceous, dark brown, solitary or gregarious. **Peridium:** 10-20 µm thick composed of 3-5 layers of large, thin-walled cells with large lumina, forming a *textura angularis*. **Pseudoparaphyses:** 2-3 µm wide, septate, simple, merging apically with pseudoparenchyma, which fills the ostiolar canal before maturation of the ascomata. **Asci:** 100-140 x 18-25 µm, 8-spored, cylindrical to clavate, short pedunculate, bitunicate, thick-walled; developing at the base of the ascomata venter. **Ascospores:** 35-50 x 7-10 µm, bi- or tri-seriate in the upper part of the ascus, uni-seriate below, fusiform, 7-11-septate, slightly constricted at the septa, particularly around the thickest cell (4th or 5th from the top), straight or curved, at first hyaline, becoming light brown (or golden brown) and verrucose in age, surrounded by a gelatinous, 2 to 4 µm thick sheath.

Habitat: Sabrobic on submerged parts of *Typha angustata* Chaub. and Bory. , Penganga River (Chikhli), 5 sept.2011leg. V.R. Patil

Distribution:- *Andhara Pradesh:* On intertidal (marine waters) wood of *Rhizophora apiculata* (as *Chaetomastia typhicola* (P. Karst.) M.E. Barr, Sarma & Vittal, 2004); *Maharashtra:* present work.

Remarks: The genus is represented by two species found in freshwater habitats (Zhang et al. 2009a, b). The general characteristics of the specimen from Buldhana district are in agreement with those reported for *Neomassariosphaeria typhicola* as described by Kohlmeyer and Kohlmeyer (1979) for *Leptosphaeria typhicola* P. Karst. Therefore, it is assigned to that species. It is an addition to the fungi of Maharashtra state. The occurrence of *Neomassariosphaeria typhicola* (as *Chaetomastia typhicola* (P. Karst.) M.E. Barr) on intertidal wood (in marine waters) of *Rhizophora apiculata* as recorded by Sarma and Vittal (2004) is unlikely, as the fungus is a substrate specific encountered on *Typha* sp.

4) *Savoryella verrucosa* Minoura & T. Muroi *Trans. Mycol. Soc. Japan*, **19**: 132 (1978).

Ascomata: 250-325 µm long, 150-250 µm diam., ellipsoidal, immersed, semi-immersed or superficial, coriaceous, pyriform, black, papillate, axis horizontal oblique or vertical to the host surface, solitary or gregarious. **Necks:** 55-70 µm long, cylindrical, smooth, subhyaline to brown, periphysate, bending upwards with pale brown to brown apex. **Peridium:** thin, brown, of *textura epidermoidea* in surface view. **Paraphyses:**

present, sparse. *Asci*: 165-210 x 25-35 µm, 8-spored, cylindrical or clavate, unitunicate, thin-walled, short pedicellate, apically thickened and truncate with a ring. *Ascospores*: 30-40 x 12-18 µm, biseriate, ellipsoid, hyaline when immature, 3-septate when mature, constricted at the septa; central cells brown, distinctly verrucose, polar cells 4-6 µm long, 4-5 µm wide, hyaline.

Habitat:- On submerged wood, Katepurna river (Chikhli), 5 sept.2011leg. V.R. Patil

Distribution:- *Karnataka*: (Sridhar et al., 2011); *Maharashtra*: present study.

Remarks: The genus is represented by twelve (one marine and freshwater, 4 obligate marine and 7 obligate freshwater) species (Abdel-Wahab and Jones, 2000; Cai et al., 2006; Jones et al., 2009). The general characteristics of the specimen from Buldhana district are in agreement with those reported for *Savoryella verrucosa* by Minoura and Muroi (1978). Hence, it is assigned to that species. It is being recorded for the first time from Maharashtra state.

5) Zopfiella karachiensis (S.L. Ahmed & Asad) Guarro
Trans. Br. Mycol. Soc., **91**: 589 (1988).

≡ *Strattonia karachiensis* Ahmed & Asad, *Sydowia*, **21**: 282 (1968).

≡ *Podospora faurelii* Mouchacca, *Rev. Mycol.*, **38**: 109 (1973).

≡ *Triangularia karachiensis* (Ahmed & Asad) Udagawa, *Trans. Mycol. Soc. Japan*, **20**: 362-365 (1979).

Ascomata: 300-375 x 250-285 µm., clothed densely with hyphal-like hairs, globose to subglobose, superficial, ostiolate, coriaceous, dark brown. *Necks*: 75-150 µm long, conical. *Peridium*: thin, membranaceous, outer layer composed of brown angular cells. *Asci*: clavate, with a short stipe, 8-spored, 100-135 x 17-23 µm. *Ascospores*: biseriate, ellipsoidal, at first 1-celled, latter becoming 2-celled, 35-40 x 12-20 µm; upper cell dark olivaceous brown to dark brown, ellipsoid, inequilateral, smooth, with a single germ pore at the apex, 23-29 x 12-20 µm; lower cell conical, hyaline often collapsed at maturity, 7-10 x 7-8 µm.

Habitat: On submerged wood, Penganga River (Chikhli), 5 sept.2011leg. V.R. Patil

Distribution:- *Tamil Nadu*: On wood test blocks (as *Triangularia karachiensis*, Udaiyan 1989); *Maharashtra*: present work.

Remarks: The general characteristics of the specimen from Buldhana district are in agreement with those reported for *Zopfiella karachiensis* (S.L. Ahmed & Asad) Guarro as provided by Udaiyan (1989). Therefore, it is assigned to that species. It is being collected for the first time from Maharashtra state.

4. Acknowledgments

Authors are thankful to Chairman, Navoday Shaikshanic Sanshta, Dhule's U.P. Arts and Science college, Dahivel, Dist.- Dhule; and Principal (Dr. R.T. Chaudhary) and Chairman of S.V.S Naik Arts, Comm. and Science college, Raver-525508, 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] Abdel-Wahab, M.A. & Jones, E.B.G. (2000) Three new marine Ascomycetes from driftwood in Australian sand dunes. *Mycoscience*, **41**: 379-388.
- [2] Bilgrami, K.S., Jamaludeen, S. & Rizwi, M.A. (1991) "*Fungi of India*", Today and Tomorrow's Printers and Publishers, New Delhi, pp. 798.
- [3] Borse, B.D., Patil, S.Y., Patil, V.R., Pawara, S.M. & Borse, K.N. (2014) Checklist of freshwater Ascomycetes in India. *J. Mycopath. Res.*, **52**: 279-284.
- [4] Cai, L., Hyde, K.D. & Tsui, C.K.M. (2006) "*Genera of freshwater fungi*". Fungal Diversity Research Series, Fungal Diversity Press, Hong Kong, China. pp. 1-261.
- [5] Cai, L., Hu, D.M., Liu, F., Hyde, K.D., & Jones, E.B.G. (2014) The molecular phylogeny of freshwater Sordariomycetes and discomycetes. In: "*Freshwater Mycology and Fungal-Like Organisms*", Walter de Gruyter, GmbH, Berlin, Germany, pp. 47-71.
- [6] Campbell, J., Anderson, J.L. & Shearer, C.A. (2003) Systematics of *Halosarpheia* based on morphological and molecular data. *Mycologia*, **95**: 530-552.
- [7] Hyde, K.D., Ho, W.H. & Tsui, K.M. (1999) The genera *Aniptodera*, *Halosarpheia*, *Nais* and *Phaeonectriella* from freshwater habitats. *Mycoscience*, **40**: 165-183.
- [8] Jamaludeen, S., Goswami, M.G. & Ojha, B.M. (2004) "*Fungi of India (1989-2001)*", Scientific Publishers (India), Jodhpur, pp. 308.
- [9] Jones, E.B.G., Sakayaroj, J., Suestrong, S., Somrithipol, S. & Pang, K.L. (2009) Classification of Ascomycota, anamorphic taxa and Basidiomycota. *Fungal Diversity*, **35**: 1-187.
- [10] Kohlmeyer, J. & Kohlmeyer, E. (1979) "*Marine Mycology: The Higher Fungi*", Academic press, New York, pp. 689.
- [11] Minoura, K. & Muroi, T. (1978) Some freshwater ascomycetes from Japan. *Trans. Mycol. Soc. Japan*. **19**: 129-134.
- [12] Sarma, V.V. & Vittal, B.P.R. (2004) Manglicolous fungi recorded from Godavary and Krishna deltas, A. P., East coast of India along with dichotomous key and notes on some taxa. *Kavaka*, **32**: 65-111.
- [13] Shearer, C.A. (1993) Freshwater Ascomycetes. *Nova Hedwigia*, **56**: 1-33.
- [14] Shearer, C.A. & Crane, J.L. (1971) Fungi of the Chesapeake bay and its tributaries. I. Patuxent river. *Mycologia*, **63**: 237-260.

- [15] Shearer, C.A., Raja, H.A., Miller, A.N., Nelson, P., Tanaka, K. et al. (2009) The molecular phylogeny of freshwater Dothideomycetes. *Studies in Mycology*, **64**: 145-145-153.
- [16] Shearer, C.A., Pang, K.L., Suetrong, S. & Raja, H.A. (2014) Phylogeny of the Dothideomycetes and other classes of freshwater fissitunicate Ascomycota. In: "Freshwater Mycology and Fungal-Like Organisms", Walter de Gruyter, GmbH, Berlin, Gemany, pp. 25-45.
- [17] Simonis, J.L., Raja, H.A. & Shearer, C.A. (2008) Extracellular enzymes and soft rot decay: Are ascomycetes important degraders in fresh water? *Fungal Diversity*, **31**: 135-146.
- [18] Sridhar, K.R., Arun, A.B., Maria, G.L. & Madhyastha, M.N. (2011) Diversity of fungi on submerged leaf and woody litter in river Kali, southern India. *EVRJ*, **5**: 1-14.
- [19] Tsui, K.M., Hyde, K.D. & Hodgkiss, I.J. (1997) A new species of Aniptodera (Ascomycetes) from Hong Kong and Philippines. *Sydowia*, **49**: 187-192.
- [20] Udaiyan, K. (1989) Some interesting ascomycetes from water cooling towers. *Kavaka*, **17**: 11-16.
- [21] Venkateshwarlu, N., Reddy, S.M. & Reddy, S.R. (1996) Hyphomycetes from Warangal – III. *Indian Phytopath.*, **49**: 339-341.
- [22] Volkmann-Kohlmeyer, B. & Kohlmeyer, J. (1996). How to prepare truly permanent microscopic slides. *Mycologist*, **10**: 107-108.
- [23] Wong, M.K.M., Goh, T.K., Hodgkiss, I.J., Hyde, K.D., Ranghoo, V.M., Tsui, K.M., Ho, W.H., Wong, S.W. and Yuen, T.C. (1998a) The role of fungi in freshwater ecosystems. *Biodivers. Conserv.*, **7**: 1187-1206.
- [24] Wong, S.W., Hyde, K.D. & Jones, E.B.G. (1998b) *Halosarpheia heterogattulata* sp. nov. from submerged wood in streams. *Can. J. Bot.*, **76**: 1857-1862.
- [25] Zhang, Y., Schoch, C. L., Fournier, J., Crous, P. W., de Gruyter, J., Woudenberg, J. H. C., Hirayama, K., Tanaka, K., Pointing, S. B. & Hyde, K. D. (2009a) Multi-locus phylogeny of Pleosporales: a taxonomic, ecological and evolutionary re-evaluation. *Studies Mycology*, **64**: 85-103.
- [26] Zhang, Y., Fournier, J., Crous, P.W., de Gruyter, J., Woudenberg, J.H.C., Hirayama, K., Tanaka, K., Pointing, S.B., Spatafora, J.W. & Hyde, K.D. (2009b) Phylogenetic and morphological assessment of two new species of *Amniculicola* and their allies (Pleosporales). *Persoonia*, **23**: 45-54.

Figure Legends

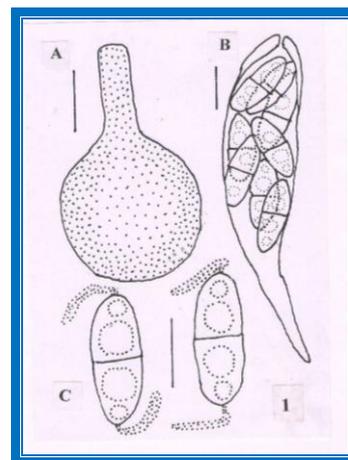


Figure 1: *Aniptodera inflatiascigera*: A-Ascocarp (bar- 200 µm), B-Ascus (bar- 20 µm), C-Ascospores (bar- 20 µm).

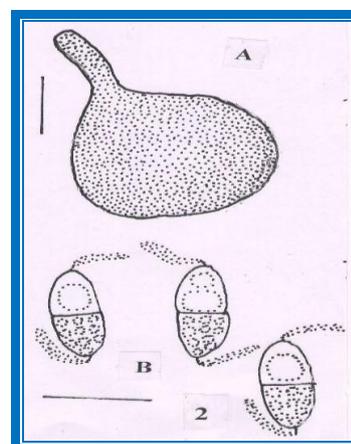


Figure 2: *Ascosacculus heterogattulata*: A-Ascocarp (bar- 20 µm), B-Ascospores (bar- 20 µm)

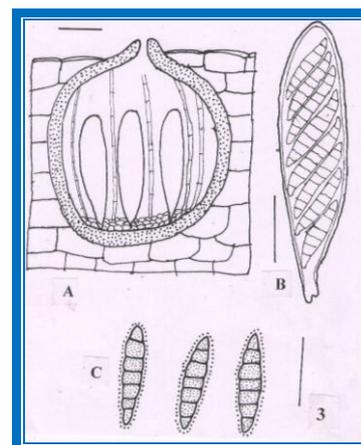


Figure 3: *Neomassariosphaeria typhicola*: A-Ascocarp (bar- 20 µm), B-Ascus (bar- 20 µm), C-Ascospores (bar- 20 µm).

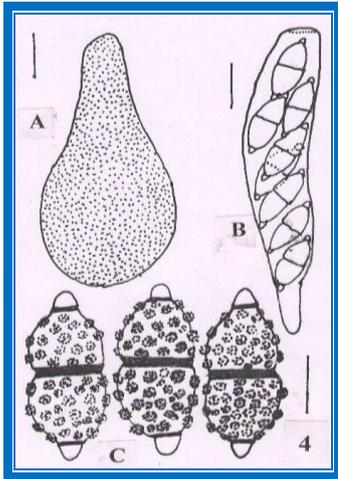


Figure 4: *Savoryella verrucosa*: A-Ascocarp (bar- 200 μm), B-Ascus (bar- 200 μm), C-Ascospores (bar- 20 μm)

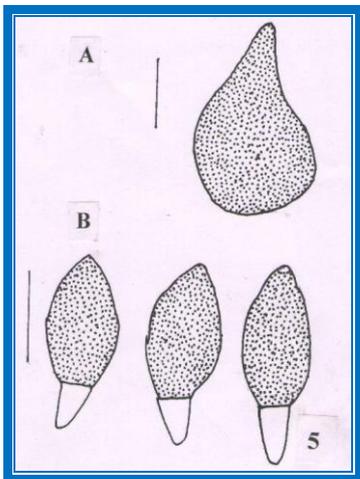


Figure 5: *Zopfiella karachiensis*: A-Ascocarp (bar- 100 μm), B-Ascospores (bar- 20 μm)