

Setosynnema limnetica sp. nov., a new mitosporic fungus on submerged leaves from the River Tapti, Maharashtra, India

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Abstract: A new taxon of freshwater mitosporic fungi *Setosynnema limnetica* collected on submerged leaves from the River Tapti in Maharashtra state, India, is described and illustrated and compared with analogous taxa *S. isthmosporum* and *S. yunnanense*. *Setosynnema limnetica* is characterized by having unbranched percurrent proliferating synnemata, devoid of setae and multiseptate scolecoform conidia without isthmus.

Key words: Mitosporic fungi, freshwater, synnemata, submerged leaves

INTRODUCTION

Setosynnema D.E. Shaw & B. Sutton was erected to accommodate a single Anamorphic (asexual) fungal species, *S. isthmosporum* from Papua New Guinea and Australia, characterized by scattered brown synnemata with whorls of setae near the apex (Shaw & Sutton 1985). The conidia are holoblastic, filiform, widest at the centre, and with an isthmus at the central septum tapered towards each end. Subsequently, Nawawi (1985) isolated this species from Malaysia, Matsushima (1996) from Japan, and Marvanova & Hywel-Jones (2000) from Thailand. Additional species has been described by Bai et al. (2013) from freshwater habitat in China and according to them *Synnematophora* K.R. Sridhar & Kaver. (type species *S. constricta*) from India (Sridhar & Kaveriappa 2002) may be a synonym of *Setosynnema*.

Agathe van Beverwijk, first coined the term 'aero-aquatic' for amphibious fungi which decompose submerged plant litter, but can produce propagules only above the water level (van Beverwijk 1951). Their propagules enclose air, are well buoyant and dispersed by floating on the water surface. This ecological group has been defined by Fisher (1977) as follows: "Aero-aquatic fungi are indwelling organisms characterized by the production of purely vegetative mycelium in substrata under water and by the formation of conidia with a special flotation device, formed only when the substrate on which the fungus is growing is exposed to a moist atmosphere." Thus, Aero-aquatic fungi are ecologically defined both by inhabiting plant litter periodically submerged in stagnant to slow-flowing water bodies, and by producing dispersal units only on substrata exposed to air (Goh and Hyde 1996). Goh (1997) stated that comparatively few Aero-aquatic fungi are known from tropical latitudes which indicate that the aero-aquatic niche is less prominent. In recent year, however, several new aero-aquatic genera and species have been described from the tropics (Yamaguchi *et al.* 2009, Chuaseeharonnachai *et al.* 2014, Sri-indrasutdhi *et al.* 2015).

According to Jones et al. (2014), there are 531 species of mitosporic fungi that had been recorded from freshwater habitats all over the world. In India, studies on freshwater mitosporic fungi (375 sp.) were compiled by Patil *et al.* (2015) and Borse *et al.* (2016, 2017). In this paper, we describe and illustrate a new areo-aquatic mitosporic fungus *Setosynnemopsis limnetica* which was found on submerged leaves from a freshwater river in India.

MATERIAL AND METHODS

The present fungus was collected on brown, partially decayed, unidentified, broad-lamina submerged leaves from mainly clear and flowing streams. After collection leaves were carried wet in plastic bags to the laboratory and transferred to Petri dishes containing tap water. The incubated water was replaced on every alternate day. After 6-8 days of incubation, a fungus with pale brown synnemata and characteristic scolecoform conidia were produced on the petiole and lamina. Synnemata were observed under a stereo-zoom microscope. Synnemata and conidia were mounted in lactic acid with cotton blue and measured using an ocular micrometer with 10 observations per structure. The holotype specimen (slides) is deposited in the Herbarium Cryptogamiae Indiae Orientalis (H.C.I.O.), Division of mycology and plant Pathology, I.A.R.I. Pusa Campus, New Delhi, India (HCIO 52063).

TAXONOMY

Setosynnema limnetica Borse and N.S. Pawar, sp. nov.

MycoBank MB829244

(Figs 1-2)

Etymology: *limneticus* from the Latin for streams

Sexual morph: not observed.

Type: **India:** Maharashtra State: Tapti River, Sonewadi (Tal. Sindkheda, Dist. Dhule, Maharashtra), on submerged decaying leaves, 26 January 1997, *B. D. Borse* (HCIO 52063- holotype).

Description: It is a synnematous aero-aquatic hyphomycete collected on brown, partially decayed, broad-lamina submerged leaves from flowing streams. Synnemata: brown, solitary, hyaline at the tip, erect, wider at the base (60-100 μm), cylindrical, unbranched, 6-7 conidiophores in surface view, 350-600 μm high, 20-35 μm wide, 55-60 μm at the apex, composed of more or less spirally arranged, closely packed hyphae, with an expanded conidia producing head, conidial head (100-110 μm high, 160-175 μm in diam at the apex, up to 50-60 μm at the base) is without setae. Synnemata that developed below water had longer shafts to transverse the water and sporulated some distance above the water meniscus. Synnemata were observed to have percurrent proliferations. After the first crop of the conidia dispersed, the bundle of hyphae in the centre of the synnema lengthened and produced next sporiferous head above the new water level by percurrent proliferation of synnema. Sometimes 3-4 such percurrent proliferations (number of scars on synnema or enlargements at the synnema) have been observed to form on a synnema. Conidiophores: unbranched, septate, and pale brown. Conidiogenous cells: integrated.

Conidia: thalloconidia, hyaline, scolecoform, septate, thin-walled, conidial development on sporiferous head synchronous. The immature conidia were filiform, non-septate with rounded tips, tapering towards both ends; soon they bend inward, resulting in a white loose cluster in the form of a rose flower. Mature conidia curved, crescent- or U-shaped, lying in one plane, some appearing sigmoid and showing distinction between the distal and the proximal end. The distal end is rounded while proximal end shows truncate scar or with a basal thin walled precurrent extension; 11-17-septate, 235-380 μm long, 4-5 μm wide in the middle region tapering to 1-1.5 μm at the ends, either separating from the conidiophores by the breakdown of a separating cell or by a disarticulation or rounding off process at a septum at the end of the conidiophore. Shrinkage in the width of conidia was seen when lacto-phenol-cotton blue was added to water mounts indicated by swollen septa.

DISCUSSION

Setosynnema limnetica fits well within *Setosynnema* based on its synnematos conidiomata, percurrent proliferation, aero-aquatic habitat and filiform septate conidia. The present fungus partially resembles with synnematos aero-aquatic fungus *Setosynnema istmosporus* Shah and Sutton (1985), freshwater fungus *S. yunnanense* Bai et al. (2013), freshwater fungus *Synnematophora constricta* Sridhar and Kaveriappa (2002) and terrestrial fungus *Setodochium triseptata* Matsushima (1971). The present fungus differs from *Setosynnema istmosporum* in having unbranched synnemata, devoid of setae, central isthmus (constriction) of conidium and in the range of size and septation. The present fungus also differs from *Setosynnema yunnanense* in having unbranched conidiophores, devoid of setae, isthmus (constriction) at the septum, and in the range of size and septation of conidia. The present fungus also differs from *Synnematophora constricta* in having proliferating synnema, devoid of central isthmus (constriction) of conidium, and in the range of size and septation. The present fungus partially resembles with sporodochial terrestrial fungus *Scolecodochium malayense* Matsushima (1996) and differs from it in having proliferating synnema and aero-aquatic habitat. The present fungus partially resembles with sporodochial terrestrial fungus *Setodochium triseptata* Matsushima (1971) and differs from it in having proliferating synnema, aero-aquatic habitat, devoid of setae, filiform (cylindrical in *S. trisetata*) conidia and in the range of septation (11-17 against 3-septate in *S. triseptata*).

Microphotographs, line drawings and description of the present fungus were sent to Prof. K. A. Seifert (Research Scientist, Biodiversity (Mycology and Microbiology), Agriculture and Agri-Food, 960 Carling Avenue, Ottawa, Ontario, K1A 0C6, Canada) for identification. He wrote: "Please have a look at *Scolecodochium malayense*. The kind of 'proliferation' of conidiomata that you draw is not shown for this fungus by Matsushima, but the other details at least seem close enough to make it worth comparing". The characteristic features of the present fungus are compared in following Table.

Table: Comparison of *Setosynnema isthmosporum*, *Synnematophora constricta*, *Scolecodochium malayense* and with the present fungus (dimensions in μm):

		<i>Setosynnema isthmosporum</i>	<i>Synnematophora constricta</i>	<i>Scolecodochium malayense</i>	Present fungus
Synnemata /Sporodochium	Colour	Brown	Pale brown	Brown / orange	Pale brown
	Length	350-1720	600-1000	5-50	350-600
	Diameter				
	Base	20.7-52.9	35-60	Absent,	60-100
	Stipe	18.4-25.3	30-55	--	20-35
	Apex	32.2-46	40-70	--	55-60
Conidia	Septa	7-8	5-9	12-18	11-17
	Length	201-260	190-270	52.5- 145	235-380
	Diameter				
	Middle	2.5-3	4.5-5.5	2.5-3.5	4-5
	Apex	1-1.5	1.5-2.5	1.5-2	1-1.5
Setae		Present	Absent	Absent	Absent
Synnema/ Sporodochium proliferation		Present	Absent	Absent	Present
Synnema/ Sporodochium braching		Branched or unbranched	Unbranched	---	Unbranched
Habitat		Aero-aquatic	Freshwater	Terrestrial	Aero-aquatic

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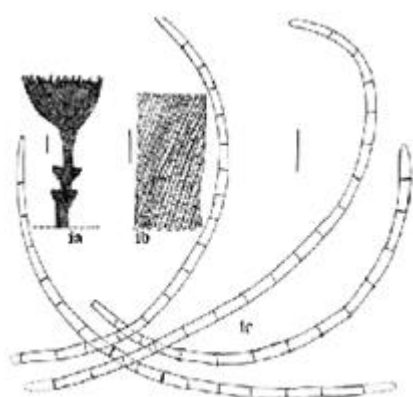


Fig.1. *Setosynnema limnetica* I: i a- Synnema, I b- part of synnema, I c- Conidia (All scale bars = 10 µm)

