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SHEATHNEMA INDICUM GEN. ET SP. NOV. A NEW SOOTY MOLD FUNGUS FROM NORTHERN WESTERN GHATS, INDIA

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Abstract: A new genus and species *Sheathnema indicum* was collected from the leaves and other aerial parts of *Pandanus tectorius* Sol. ex Park. from the forest areas of Sawantwadi Taluka, Sindhudurg District, Maharashtra. Morphologically this new genus is a synnematus fungus and can be easily differentiated from similar genera such as, *Spiropes*, *Dematophora*, *Tharoopama*, *Phaeoisariopsis*, *Graphium*, *Leptographium* and various other synnematus forms in having a dark brown infertile sheath completely covering the synnemata at the young stage and partially covering the fruiting body at the mature stage. Besides this it can also be differentiated from other allied genera in having 2–3 septate hyaline to sub hyaline conidia. A description, illustrations and comparison with other allied taxa are presented hereafter.

Keywords: Ascomycetes, new genus, morphotaxonomy, Sheath, sooty mold, Synnemata.

The forests, micro habitats and tropical warm humid climate that prevail in the Western Ghats support many rare and new forms of fungi. During January 2012, surveys were conducted to explore the microbial diversity in the natural forests of Sawantwadi, situated at an altitude of 690m in southern Maharashtra, which resulted in the collection of a rare fungi subsequently determined to be a new genus. The present study describes and illustrates this unusual interesting sooty mold fungus collected from the Sawantwadi Taluka of Maharashtra.

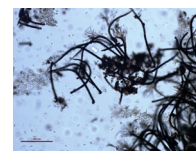
MATERIAL AND METHODS

Surface scraping of the aerial parts bearing the sooty mold fungus was taken and mounted in lactophenol



DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	ENDANGERED	CRITICALLY ENDANGERED	EXTINCT IN THE WILD	EXTINCT
DD	LC	NT	VU	EN	CR	EW	EX

Sheathnema indicum



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cotton blue mixture for microscopic examination. For micrometric measurements slides were observed under a Nikon compound microscope (Model Nikon Eclipse 50i). For morphotaxonomic studies and photomicrographs the Nikon microscope attached with a digital camera Nikon DS Fi 1 were used. The type specimen (Holotype) was accessioned and has been deposited in Ajrekar Mycological Herbarium (AMH) Pune, India for further reference. An isotype has been deposited at the Botanical Survey of India, Pune for further reference. Morphotaxonomic comparisons were made with allied taxa. Descriptions and nomenclatural details were deposited at MycoBank <www.mycobank.org>.

***Sheathnema* Dubey & Moonambeth gen. nov.**

(urn:lsid:indexfungorum.org:names: 802964).

(Fungi: Ascomycetes: Sheathnema)

(Images 1–13)

Colony epiphyllous, dense, velvety, hyphae straight to effuse, dark blackish-brown, tufted, with large, black synematosus like fruiting body occurring in association with meliolales fungi. Stroma none, setae and hyphopodia absent. Synemata dark brown, erect and curved at the apex appearing just like a boomerang and completely remains covered by a dark brown, infertile sheath at the young stage. On maturity, the upper half portion of synnemata bearing conidiophores and conidia slowly splay out and finally spreads widely in the form of a brush leaving the dark brown sheath aside. Consequently, long dark brown synnemata bearing a single, long dark brown, continuous infertile sheath casing lower half stalk forming portion of fruiting body and exposing the upper half fertile wide part bearing

conidiophores and conidia are visible. Stalk is composed of numerous pale, olivaceous brown, unbranched or rarely branched parallel hyphae which progressively become free and diverge from main stalk to form the conidiophores. Conidiophores are pale brown, becoming hyaline towards the tip, macronematous, mononematous, unbranched, rarely branched in lower portion of hyphae, repeatedly having geniculations, diverging at various angles, straight, bend and curved. Conidiogenous cells polyblastic, integrated terminal or discrete, determinate, sympoidal, geniculate, smooth. Conidia acropleurogenous, single or in groups of 4–5, long, hyaline to subhyaline, mostly with three septa, clavate to sub-clavate, rounded at the apex, tapered to the base, smooth.

***Sheathnema indicum* sp. nov.**

Dubey & Moonambeth

(urn:lsid:indexfungorum.org:names: 810081)

(Images 1–13)

Material examined

B.S.I. (W.C.) 200140, AMH 9599 (Holotype), BSI 132411 (Isotype), 21.i.2012, on aerial parts of *Pandanus tectorius* Sol. ex Park. Family Pandanaceae 16.00°N & 73.75°E, elevation 111.86m, Sawantwadi Taluka, Sindhudurg District, Maharashtra, India, coll. Rashmi Dubey.

Colonies dark brown, aggregated with large, black synematosus fungi; sheath covers the synemata at the young stage and is up to 470µm long, 6.6–8.5 µm wide near the base and 2.5–4.0 µm wide near the apex. At the mature stage the upper part of synnemata bearing conidiophores and conidia slowly splay out leaving



Images 1–2. *Sheathnema indicum* gen. et sp. nov. 1 - Diseased Plant of *Pandanus tectorius* Sol. Ex Park; 2- Colony (X100).



Image 3. Immature synemata entirely covered with a sheath (X200)

the sheath running aside and measures about 60–90 x 36–79 μm, while the lower portion of synemata with sheath forms stalk. Sheath sterile, up to 470 μm long, 7–9 μm wide at the base and 2–3 μm wide at the apex, dark blackish-brown and becomes hyaline at the tip. Stalk 73.6–90.50 x 4.75–6.5 μm, having numerous pale, olivaceous brown, unbranched parallel hyphae covered with a sheath; conidiophores 35.81 x 69.55–36.4 x 86.64 μm in upper part of synemata, with a sheath running one side. Conidia hyaline to sub hyaline, 3-septate clavate to subclavate, rounded at the apex, tapered to the base, smooth 9.02–12.25 x 2.5–3.20 μm.

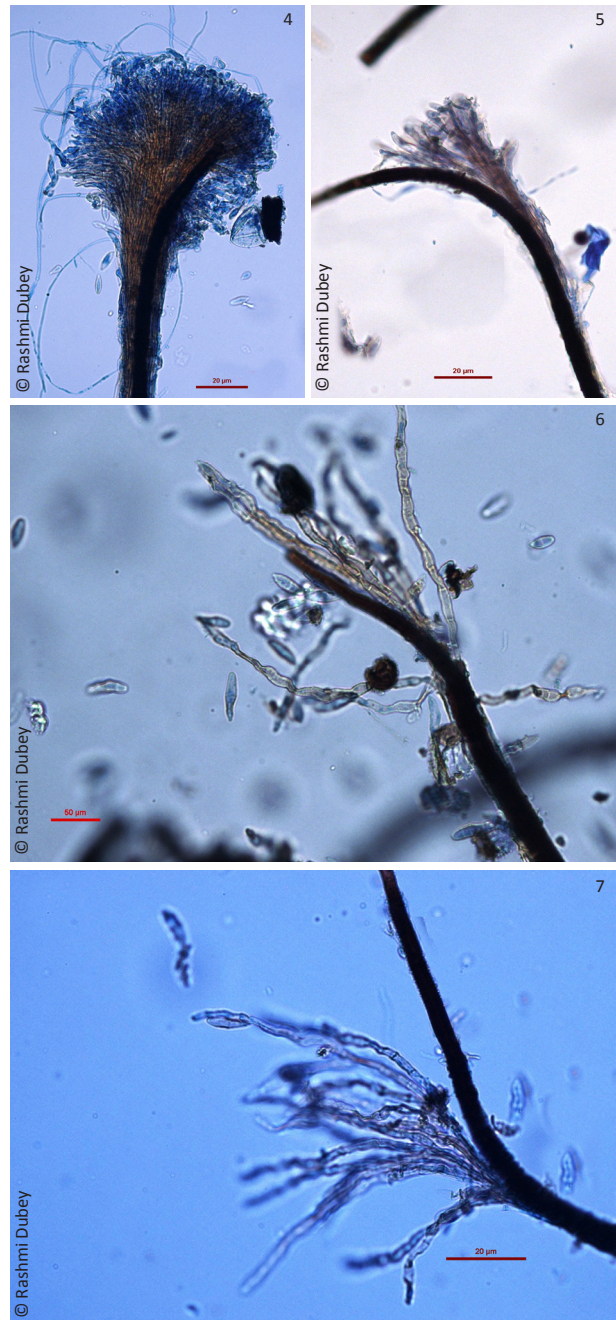
Etymology: The genus name has been proposed on the basis of the presence of sheath on synematous form and species name is proposed on the name country from where it is reported.

Teleomorph: Unknown/ not observed.

Known distribution: Found in the natural forest of the northern Western Ghats.

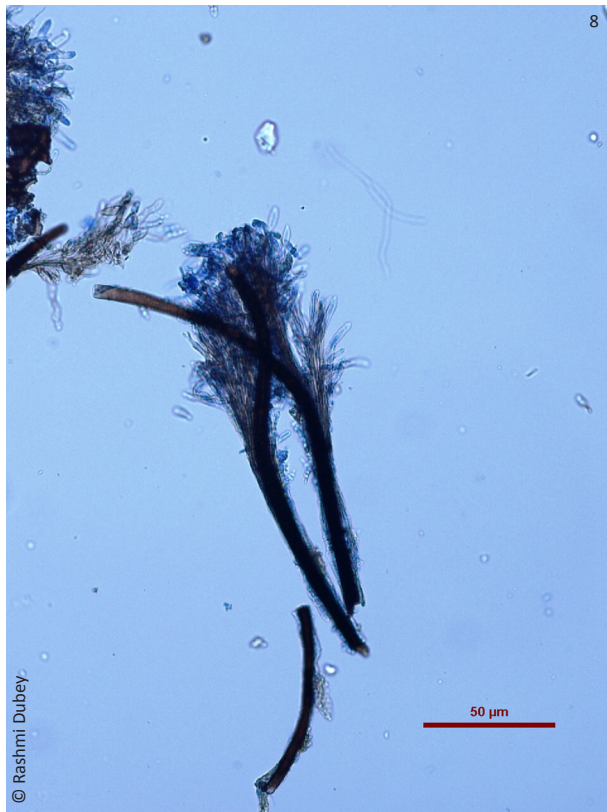
DISCUSSION AND CONCLUSION

Considering the synematal structure *Sheathnema* can be classified under family Stillbelaceae (Fr.) 1821, which accommodate certain synnematosus fungus like *Spiropes* (Ciferri, 1955), *Dematophora* (Hartig, 1883), *Tharoopama* (Subram., 1956), *Annelophragmia* (Subram., 1963), *Leptographium* (Lagerb. & Melin, 1927), *Graphium*, (Corda, 1837), *Stilbum* (Tode, 1790),

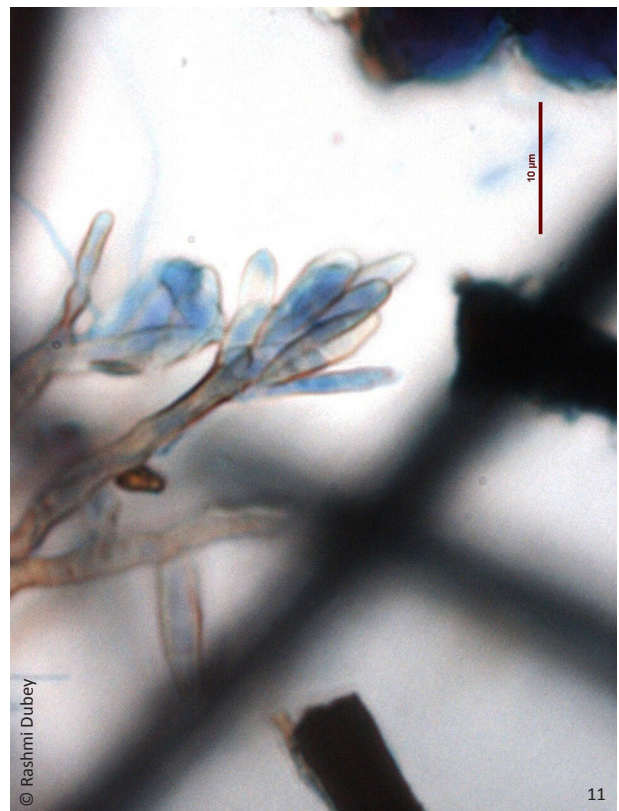
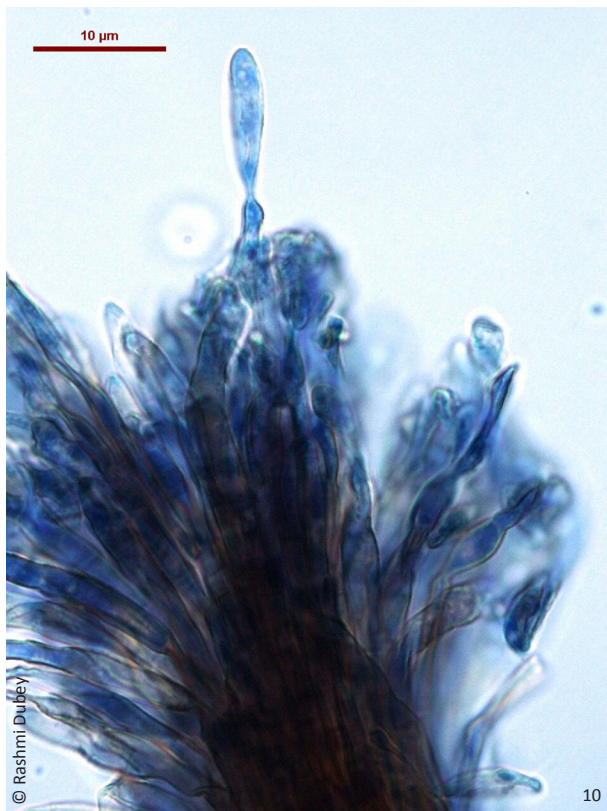


Images 4–7. Sheath detaching from upper half part of fruiting body at X400.

Phaeoisariopsis (Ferraris, 1909), *Arthrobotryum* (Cesati, 1854) and many more forms. However, according to the latest classification of Fungi the family Stillbelaceae has been merged with Ascomycotina (Kirk et al. 2008). After accomplishment of comprehensive studies (Seifert 1985) it was realized that the present fungus bears a unique identity in having a sheath completely covering the synemata at a young stage and partially at a mature



Images 8–9. Mature synemata (X200)



Images 10–11. Conidia and conidiophores (X1000)

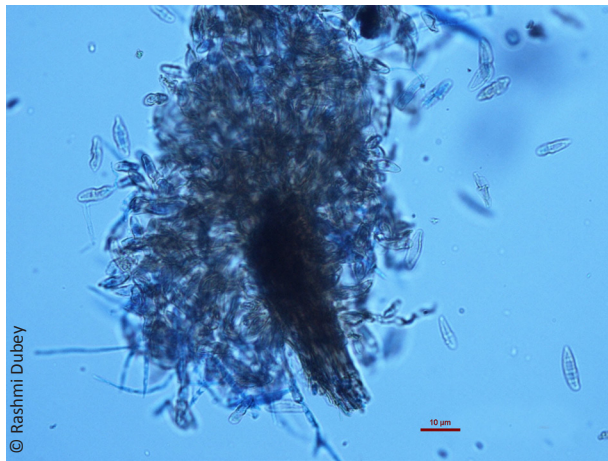


Image 12. Conidia and conidiophores X400

stage. No synematosus form has been reported with a sheath and such characteristics. Stillbelaceae members like *Tilachlidiopsis* Auct, *Polcephalomyces* Kobayashi, *Hisutella* Pat., *Solheimia* Morris, *Phaeostibella* Honnel, *Stilbum* Tode, *Stilbella* Lindau, *Stromatographium* Hohnel, *Phialographium* Upadhyay & Kendrick, *Crinula* fr., *Dennisographium* Rifai, *Meniosporopsis* Hughes, *Thozetella* Kuntze, *Rhizostibella* Walk, *Didymostilbe* Henn., *Eustilbum* Rabenh, *Coryne* Nees, *Dendrostilbella*, *Tubercularia* Tode possess amerspores with synematosus fruiting body, likewise *Acrostroma* Seifert, 1987 and *Agarwalomyces* Verma & Kamal, 1987 also possess unicellular conidia in a chain, while other genera like *Didymostilbe* Henn, *Pseudographiella* Petch, *Stachycoremium* Seifert, *Actinostilbe* Petch possess didymospores with a synematosus type of fruiting body, while the proposed genus possesses phragmospores with a sheath on the fruiting body.

However, the proposed genus shows some resemblance in other morpho-taxonomic characteristics with a few synematosus forms. It resembles certain other synematosus forms like *Spiropes*, *Phaeoisariopsis*, *Arthrobotryum*, *Phragmocephala* (Mason & Hughes, 1951), *Endophragmia* (Duvernoy & Maire 1920) etc., in having phragmospores. Colonies of *Spiropes* also occur in association with meliiales fungi, but it differs from *Sheathnema* in its conidiogenous cells which are with prominent scars and is cicatrized, and the conidia are also solitary, subhyaline to dark brown, whereas conidiogenous cells of *Sheathnema* are smooth and conidia are solitary or in groups and is clavate to subclavate. *Phaeoisariopsis* differs from *Sheathnema* in possessing cicatrized scars on conidiogenous cells and having stromata, on the contrary the conidiogenous



Image 13. Conidia at X1000.

cells of *Sheathnema* are smooth and stromata are totally absent. *Arthrobotryum* also has phragmospores but it differs from *Sheathnema* in having scattered synemata and the conidiogenous cells are percurrent with upto seven annelations, whereas synemata of *Sheathnema* has hyphae which are closely ad pressed along their length and splay out like a brush at the apex leaving the sheath aside and more over the conidiogenous cells are determinate in it. In *Endophragmia* the overall morphology resembles *Sheathnema* besides sheath but the conidia are 1–5 septate frequently with dark black bands at the septa. *Sheathnema* differs from the synematosus forms like *Prathoda* (Subram, 1956) and *Trochospora* (Moore, 1955) which have scoleospores and helicospores respectively, whereas the proposed genus has phragmospores. *Sheathnema* also possesses determinate conidiogenous cell which separates it from other synematosus fungi like *Graphium* (Corda, 1837) *Leptographium* (Lagerberg et al. 1927), *Doratomyces* (Corda, 1829) which have per current conidiogenous cells. In synematosus fungi like *Spiropes*, *Tharoopama*, *Dendrographium* (Masse, 1892), *Phaeoisaria* (Hohnel, 1909) and *Phaeoisariopsis* the conidiophores are macronematosus, synematosus, individual threads are closely adpressed along their length and splay out the apex as well as the conidiogenous cells are polyblastic, integrated and determinate, conidia are hyaline to pale olivaceous brown and smooth. The overall morphology of the above mentioned genera coincides with the morphological characteristics of *Sheathnema* except

Table 1. Comparison of *Sheathnema* gen. nov. with other related genera.

Genus	Fruiting body	Sheath covering fruiting body	Conidiophores	Conidiogenous cells	Conidia	References
<i>Spiropes</i>	Synematous or sometimes the conidiophores are in loose fascicles.	Absent	Unbranched	Polyblastic, cicatrized, scars numerous and prominent.	Solitary, dry, mostly obclavate, fusiform or oblong, smooth or verruculose, 1–9 transverse septate.	Ciferri (1955)
<i>Dematophora</i>	Synematous	Absent	Simple branching, with geniculations.	Ployblastic, denticulate with short minute collar at each geniculations	One celled, ellipsoidal or obovoid, colourless to pale olivaceous brown, 0-septate, smooth, solitary, acropleurogenous.	Hartig. (1883)
<i>Tharoopama</i>	Synematous	Absent	Verticillate branching with geniculations	Polyblastic and smooth.	One celled, hyaline, globose, acrogenous.	Subram. (1956)
<i>Phaeoisariopsis</i>	Synematous	Absent	Unbranched	Polyblastic, cicatrized, scars thin.	Three or more septate, solitary, olivaceous brown or brown, smooth or verruculose, acropleurogenous.	Ferraris. (1909)
<i>Sheathnema</i> gen. nov.	Synematous	Synemata completely covered with a dark brown sheath in young stage and partially covered in a mature stage.	Unbranched or sometimes rarely branched, with repeated geniculations.	Ployblastic and smooth.	Mostly three septate, hyaline, solitary or in groups, clavate to subclavate, rounded at the apex and narrow at base acropleurogenous.	-

the sheath and conidial structure. The characteristics of the geniculated conidiophores of *Tharoopama* and *Dematophora* are also present in *Sheathnema*. But detailed studies reveal that in *Dematophora*, the conidiogenous cells are denticulate with a short minute collar at each geniculation and more over the conidia are atherospores, ellipsoidal and ovoid, whereas in the proposed genus the conidiogenous cells are smooth and integrated along with the geniculated conidiophores and the conidia are hyaline broadly clavate to subclavate, three septate and the fruiting body is covered with a sheath. In addition to this *Tharoopama* also bear a resemblance with *Sheathnema* in having geniculations in conidiophores, but differs from it in having repeated branching in conidiophores. *Phaeoisariopsis* resembles *Sheathnema* in having unbranched or simple branching conidiophores and three septate conidia, but differs from *Sheathnema* in having cicatrized scars on conidiophores as mentioned earlier. In *Morrisographium* Morelet the conidiogenous zone in synemata is conspicuously concave and the synemata is dark with falcate, 1–3 septate conidia. In *Virgatospora* Finley the conidia are more than three septate and green in mass; similarly in *Pseudographiella* Morris the conidia are more than three septate but are yellow or orange in mass, while *Ciferrioxylum* Batista & Maia is a sooty mold fungus and the synemata is dark with 3–10 septate conidia, equally *Phialoarthrobotyum* Mats is a saprophytic genus with three or more septate conidia. Besides having

phragmospores all the above mentioned genera totally differ from *Sheathnema* as the proposed genera is unique in having a sheath on synemata.

Thus, the above discussion noticeably postulates that with the exclusion of sheath, *Sheathnema* to some extent comes closer to *Spiropes*, *Tharoopama*, *Dematophora* and *Phaeoisariopsis* in overall morphology of synemata, but *Sheathnema* still differs from this genera as revealed in Table 1. No synematal genus has been reported to possess a sheath covering the synemata. The major differences in the morphological characteristics with related genera warrant this taxon to be assigned to a new genus. Hence, it is proposed to be placed as a new genus named *Sheathnema* with type species *S. indicum*.

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