

INDIAN CONTRIBUTIONS TO THE GENUS *SYNCEPHALIS* TIEGH. AND G. LE MONN.

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Abstract : *Syncephalis* Tiegh. & G. Le Monn. is an obligate mycoparasite on members of Mortierellomycotina and Mucoromycotina. It usually parasitizes the species of *Rhizopus*, *Mucor*, *Cunninghamella* and *Choanephora* etc. *Syncephalis* is represented by seventy one taxa, including sixty five species and six varieties. Indian mycologists contributed significantly towards the genus *Syncephalis*. Till date, ten valid species and two valid varieties have been recorded by Indian mycologists in the genus *Syncephalis*.

Keywords: *Syncephalis*, *Piptocephalidaceae*, *Taxonomy*, *Indian mycologists*.

INTRODUCTION

Genus *Syncephalis* was established by Van Tieghem and Le Monnier in 1873. The genus includes several species that are obligate mycoparasites. Their usual hosts include several saprobic microfungi which fall in the subphylum Mortierellomycotina and Mucoromycotina (Baker *et al.*, 1977). Several zygomycetes, like species of *Rhizopus*, *Mucor*, *Cunninghamella* and *Choanephora* are among the favourite hosts of *Syncephalis*. Species of *Syncephalis* (Zoopagomycotina, Piptocephalidaceae) are common in soil and can be found growing on a variety of substrates in nature like herbivore dung, soil, fruits, plant debris or humus etc., which support a suitable fungal host.

Morphological characteristics of a typical *Syncephalis* species include a single, straight or recurved sporophore with basal rhizoids. Sporophore supports a terminal fertile vesicle, which bears a number of branched or unbranched, cylindrical merosporangia (Benjamin 1959, 1966, 1985). The traditional morphological classification relied upon several characters such as shape of sporophore and vesicle, ornamentation of spore, number of merospores per merosporangium, the arrangement of merosporangia vesicle and merosporangial branching pattern (Ho, 2001).

TAXONOMICAL DISCUSSIONS

At the time of establishment of the genus *Syncephalis*, Van Tieghem and Le Monnier (1873), described five species in the genus *viz.* (i) *S. asymmetrica*; (ii) *S. cordata* (iii) *S. cornu*; (iv) *S. depressa*; and (v) *S. minima*. Later on Van Tieghem made several new additions to the genus *i.e.* (i) *S. fasciculata*; (ii) *S. intermedia*; (iii) *S. nodosa*; (iv) *S. ramosa*; (v) *S. reflexa*; (vi) *S. sphaerica*; (vii) *S. tetrathela* and (viii) *S. ventricosa* in 1875 and subsequently (i) *S. furcata*; (ii) *S. nigricans* and (iii) *S. pendula* in 1878.

After over a century of the establishment of the genus, it comprised of almost forty seven species (Benjamin, 1985). Several new species and varieties continued to be discovered by different scientists from different parts of the globe. Benny *et al.* (2016) added five new species to the genus *viz.* (i) *S. digitata*; (ii) *S. floridana*; (iii) *S. pseudoplumigaleta*; (iv) *S. pyriformis* and (v) *S. unisporea*. Recently, Benny and Smith (2018) recognized *S. aethiopica* making the list upto having seventy one taxa, including sixty five species and six varieties (www.indexfungorum.org). The genus *Syncephalis* was originally placed under family Piptocephalidaceae in order Mucorales. However, on the basis of the similarities with Zoopagaceae, Piptocephalidaceae was later on transferred to order Zoopagales (Krisel, 1969). Disintegration of the phylum Zygomycota by Hibbett *et al.* (2007) resulted in shuffling of Zoopagales into subphyla Zoopagomycotina.

INDIAN CONTRIBUTION TO THE GENUS

In India, earlier efforts of several workers (Ginai, 1936; Ramakrishnan, 1955; Mehrotra, 1959; Mehrotra and Prasad, 1964) resulted in some new records of *S. sphaerica* Tiegh., *S. cornu* Tiegh. & G. Le Monn., *S. reflexa* Tiegh., *S. nodosa* Tiegh. and *S. depressa* Tiegh. & G. Le Monn.

Regarding the genus *Syncephalis*, contribution of B. S. Mehrotra and R. Prasad cannot be overlooked. In total, the duo established four new species, one new variety and several new reports from India. Mehrotra and Prasad (1966) reported *S. tenuis* Thaxt. and *S. furcata* Tiegh. as new records from India. They also recognised *S. drechsleri* as a new species and named it after Dr. Charles Drechsler, who might have isolated it for the very first time but not named it. Mehrotra and Prasad (1967) reported *S. bisporea* Racib. as a new report from India and *S. pycnosperma* var. *subglobosa* as a new variety. Later on they also described *S. trisporea*, *S. vivipera* and *S. rosetta* as new species (Mehrotra and Prasad 1968; Mehrotra and Prasad 1970; Prasad and Mehrotra 1979).

Singh and Sarbhoy (1976) established *S. indica* as a new species. They isolated it from soil and named it after the place of its country's origin. Pasricha and Mukerji (1987) described *S. heteriformis* as a new species which was growing on *Circenella muscae* on rabbit dung. Last but not the least contribution to the genus was made by Patil and Patil (1994). They established four new species to the genus i.e. (i) *S. agglutinospora*; (ii) *S. confusa*; (iii) *S. pygmae* and (iv) *S. tetraspora*. They also described *S. asymmetrica* var. *minuta* as a new variety. It is evident from the above discussion that Indian mycologists contributed significantly towards the genus *Syncephalis*. Till date, there are ten valid species and two valid varieties in the genus *Syncephalis*, which have been established by mycologists from India (Table 1).

TABLE 1 ABOUT HERE

Table 1: The species of *Syncephalis* established from India

	Taxon Name	Author	Year	Locality
1	<i>Syncephalis agglutinospora</i>	M.S. Patil & B.J. Patil	1994	Kolhapur, Maharashtra, India.
2	<i>Syncephalis asymmetrica</i> var. <i>minuta</i>	M.S. Patil & B.J. Patil	1994	Kolhapur, Maharashtra, India.
3	<i>Syncephalis confusa</i>	M.S. Patil & B.J. Patil	1994	Kolhapur, Maharashtra, India.
4	<i>Syncephalis drechsleri</i>	B. S. Mehrotra & R. Prasad	1966	Jaunpur, Uttar Pradesh, India.
5	<i>Syncephalis heteriformis</i>	Pasricha & Mukerji	1987	Delhi, India.
6	<i>Syncephalis indica</i>	S.N. Singh & A.K. Sarbhoy	1976	Jodhpur, Rajasthan, India.
7	<i>Syncephalis pycnosperma</i> var. <i>subglobosa</i>	B. S. Mehrotra & R. Prasad	1967	Allahabad, Uttar Pradesh, India.
8	<i>Syncephalis pygmae</i>	M.S. Patil & B.J. Patil	1994	Kolhapur, Maharashtra, India.
9	<i>Syncephalis rosetta</i>	R. Prasad & B. S. Mehrotra	1979	Allahabad, Uttar Pradesh, India.
10	<i>Syncephalis tetraspora</i>	M.S. Patil & B.J. Patil	1994	Kolhapur, Maharashtra, India.
11	<i>Syncephalis trisporea</i>	B. S. Mehrotra & R. Prasad	1968	Allahabad, Uttar Pradesh, India.
12	<i>Syncephalis vivipera</i>	B. S. Mehrotra & R. Prasad	1970	Allahabad, Uttar Pradesh, India.

REFERENCES

- Baker, K.L., Hooperg, R. & Benekee, S. (1977). Ultrastructural development of merosporangia in the mycoparasite *Syncephalis sphaerica* (Mucorales). *Can. J. Bot.*, 55: 2207-2215.
- Benjamin, R.K. (1959). The merosporangiferous Mucorales. *Aliso*, 4: 321-433.
- Benjamin, R.K. (1966). The merosporangium. *Mycologia*, 58: 1-42.
- Benjamin, R.K. (1985). A novel new species of *Syncephalis* (Zoopagales: Piptocephalidaceae from California that forms hypogenous merosporangia. *Aliso*, 11: 1-15.

- Benny, G.E & Smith, M.E. (2018). Notes on *Syncephalis* (Zoopgales, Zoopagomycota) from the Farlow Herbarium, with the description of a new species, *Syncephalis aethiopica*. Mycologia, 110: 192-200.
- Benny, G.L., Ho, H.M., Lazarus, K.L. & Smith, M.E. (2016). Five new species of the obligate mycoparasite *Syncephalis* (Zoopagales, Zoopagomycotina) from soil. Mycologia, 108: 1114-1129
- Ginai, M. A. (1936). Further contribution to a knowledge of Indian coprophilous fungi. J. Indian Bot. Soc., 15: 269-284.
- Hibbett, D.S., Binder, M., Bischoff, J.F., Blackwell, M., Cannon, P.F., Eriksson, O.E., Huhndorf, S., James, T., Kirk, P.M., Lücking, R., Thorsten Lumbsch H., Lutzoni, F., Matheny, P.B., McLaughlin, D.J., Powell, M.J., Redhead, S., Schoch, C.L., Spatafora, J.W., Stalpers, J.A., Vilgalys, R., Aime, M.C., Aptroot, A., Bauer, R., Begerow, D., Benny, G.L., Castlebury, L.A., Crous, P.W., Dai, Y.C., Gams, W., Geiser, D.M., Griffith, G.W., Gueidan, C., Hawksworth, D.L., Hestmark, G., Hosaka, K., Humber, R.A., Hyde, K.D., Ironside, J.E., Kõljalg, U., Kurtzman, C.P., Larsson, K.H., Lichtwardt, R., Longcore, J., Miadlikowska, J., Miller, A., Moncalvo, J.M., Mozley-Standridge, S., Oberwinkler, F., Parmasto, E., Reeb, V., Rogers, J.D., Roux, C., Ryvarden, L., Sampaio, J.P., Schüssler, A., Sugiyama, J., Thorn, R.G., Tibell, L., Untereiner, W.A., Walker, C., Wang, Z., Weir, A., Weiss, M., White, M.M., Winka, K., Yao, Y.J. & Zhang, N. (2007). A higher-level phylogenetic classification of the Fungi. Mycological Research, 111: 509-547.
- Ho, H.M. (2001). The Merosporangiferous fungi from Taiwan (I): two new records of *Syncephalis*. Taiwania, 46: 318-324.
- Kreisel, H. (1969). Grundzüge eines natürlichen Systems der Pilze. : J. Cramer, Lehre. pp. 245.
- Mehrotra, B. S. (1959). Studies in the Mucorales. I. *Syncephalis nodosa* van Tieghem. Proc. Nat. Acad. Sci., 29: 94-96.
- Mehrotra, B.S. & Prasad, R. (1964). *Syncephalis depressa* from India. Mycologia, 56: 905-908.
- Mehrotra, B.S. & Prasad, R. (1966). Species of *Syncephalis* from India I. Sydowia. Annales Mycologici. Ser. II, 19: 112-116.
- Mehrotra, B.S. & Prasad, R. (1967). Species of *Syncephalis* from India II. Mycopathologia. Mycol. Appl., 32: 199-204.
- Mehrotra, B.S. & Prasad, R. (1968). Species of *Syncephalis* from India III. Sydowia. Annales Mycologici, 21: 125-129.
- Mehrotra, B.S. & Prasad, R. (1970). An interesting new species of *Syncephalis* from India. Sydowia, 23: 92-94.
- Pasricha, R. & Mukerji, K.G. (1987). Studies on Indian coprophilous fungi IV. Two interesting members of Mucorales. Nova Hedwigia, 44: 523-526.
- Patil, M.S. & Patil, B.J. (1994). Studies in Mucorales: Piptocephalidaceae. Indian Phytopathol., 43: 217-225.
- Prasad, R. & Mehrotra, B.S. (1979). Species of *Syncephalis* from India V. *Syncephalis rosetta* sp. nov. Beih. Nova Hedwigia, 63: 34-39.
- Ramakrishnan, K. (1955). Some aspects of soil fungal ecology. Proc. Indian Acad. Sci. B., 41: 110-116.
- Singh, S.N. & Sarbhoy, A.K. (1976). *Syncephalis indica* sp. from India. Zhl. Bakt. Aht., II 131: 201-204.
- van Tieghem, P. & Le Monnier, G. (1873). Recherches sur les Mucorinees. Ann. Sci. Nat. Bot. Ser., V 17: 261-399.
- van Tieghem, P. (1875). Nouvelles recherches sur les Mucorinées. Ann. Sci. Nat., Bot., Sér., VI 1:5-175.
- van Tieghem, P. (1878). Troisième mémoire sur les Mucorinées. Ann. Sci. Nat., Bot., Sér., VI 4:312-398.