



Reproductive phases in *Girishia indica* Prabhujii link connection between families of Pythiaceae and Saprolegniaceae

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A new member of family Saprolegniaceae – *Girishia indica* Prabhujii has been described and explained. *G. indica* exhibits well defined reproductive phases and indicates certain typical characteristics of its own. Vegetative structures and development of reproductive stages shows its alliance with family Saprolegniaceae whereas the zoospore release from the zoosporangium has been typically identical to *Pythium* of family Pythiaceae. Therefore, *G. indica* may logically be considered in the “connecting-link” position in between Pythiaceae and Saprolegniaceae. .

Keywords : *Girishia indica*, Reproductive stages, Saprolegniaceae, Pythiaceae, Connecting link.

Watermoulds, particularly the members of family Saprolegniaceae, form part of the rich aquatic fungal flora of ponds and rivers and the soils of nearby areas. There have been several reports by a vast array of aquatic mycologists (Johnson 1956, Srivastava 1967, Seymour 1970, Prabhujii 1979, Sinha 1985, Johnson *et al.* 2002 and Prabhujii 2005, 2010, 2011, Prabhujii *et al.* 2009, 2010) to this effect. Taxonomic and phylogenetic analysis of Saprolegniaceae has been made by Leclerc *et al.* (2000). A new member of family Saprolegniaceae – *Girishia indica* Prabhujii has recently been described and explained (Prabhujii and Srivastava 2014, Prabhujii 2021) with certain interesting reproductive features.

Girishia indica develops spherical, rarely oval zoosporangia, mostly terminal, but in rare cases lateral in position near the sporangial base. The hyphal cytoplasm streams towards the gradually swelling hyphal tip taking the shape of spherical zoosporangium which, at maturity cuts off by transverse basal septum. The zoospores are quickly differentiated which are monomorphic, pyriform, emerging from the zoosporangium by deliquescence of the sporangial wall and swimming immediately. Following the release of zoospores there remains no trace of any empty

zoosporangium, only the fragments of sporangial wall are visible at base (Fig. 1). The hyphal tip proliferates into new zoosporangium by protoplasmic streaming again.

The cultures of *Girishia indica* distinctly indicate the characteristics of family Saprolegniaceae – the zoospores are cleaved within the zoosporangium, precisely in the typical saprolegniacean fashion and the sexual apparatus is undeniably of oömycetous nature and is not different in its configuration from the usual water moulds. The most important and characteristic feature of this, is the active release of biflagellate planonts from the zoosporangium.

In *Pythium* sp. (Pythiaceae), it develops a sac-like vesicle from the zoosporangium in which the entire content is transferred and then, is differentiated into biflagellate zoospores there and finally, released at maturity following breaking of the vesicle and the vesicle membrane (wall) is lost. Similarly, in *Girishia indica* (Saprolegniaceae), the hyphal tip gradually enlarges into spherical zoosporangium with the streaming of protoplasm towards the tip, cut off by the basal septum and is differentiated into zoospores there; and, finally, released at maturity leaving only the fragment traces of the wall (Figs. 1 and 2).

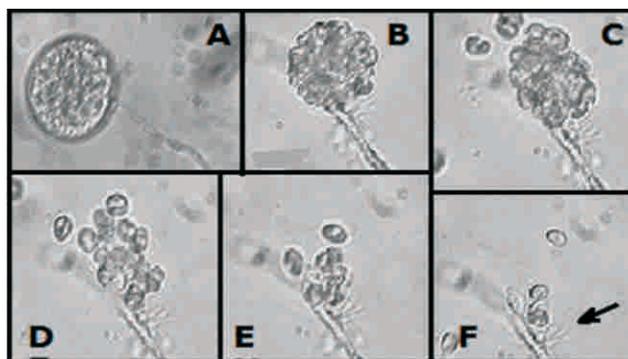


Fig. 1 A–F : Zoosporangium and release of zoospores in *Girishia indica*. A: Mature zoosporangium developed following streaming of protoplasm towards the tip; B: Differentiated zoospores in zoosporangium; C-F: Release of zoospores with breaking of the sporangial wall; Arrow shows fragments of sporangial wall.

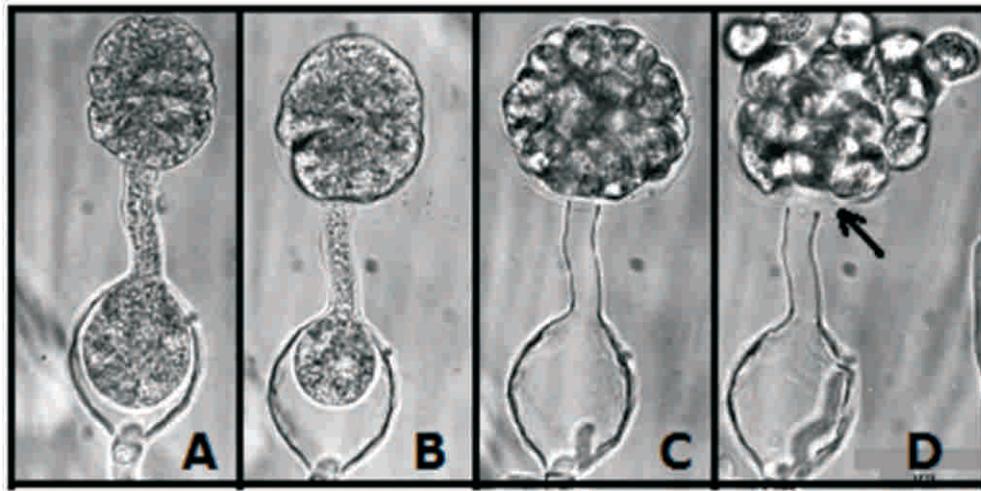
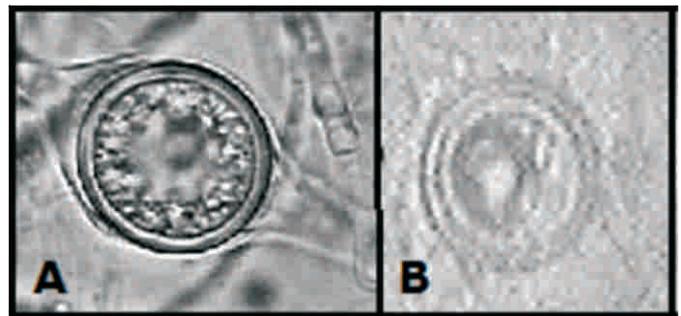


Fig. 2 A–D: Development of vesicle, transfer of content from zoosporangium; differentiation of zoospores and their release in *Pythium debaryanum*. A: Formation of vesicle and transfer of zoosporangial content; B-C: Complete transfer of content and zoospore differentiation; D: Zoospore release from the vesicle; arrow shows dissolution of the vesicle wall.

The reproductive characteristics observed in the cultures of *Girishia indica* are quite different from all the existing members of family Saprolegniaceae. It has been found to exhibit a certain degree of alliance with *Thraustotheca* in the sense that the zoospores are being released on the deliquescence of the sporangial wall, however, in *Thraustotheca* primary zoospores encyst within the sporangium whereas *G. indica* shows an active release of zoospores. Other differences are – presence of gemmae, oögonial wall pitting, one to several oöspores per oögonium and presence of abundant, dichinous, branched antheridia in *Thraustotheca*. Another genus, exhibiting minor alliance with *G. indica*, is *Aphanodictyon*, but, the differences are more significant. In *Aphanodictyon* zoospores encyst within the zoosporangium and emerge individually as laterally biflagellate planonts, leaving the cysts intact in sporangium in a dictyuchoid fashion and the oögonial wall is ornamented; which differ from *G. indica*.

Girishia indica develops eccentric oöspores (Fig. 3) as the perfect stage spores and therefore, exhibits its inclination towards Saprolegniaceae and is a member of this family. Therefore, this has been a distinct indication that *G. indica* has characteristics of family Saprolegniaceae on one hand and has asexual characters of family Pythiaceae on the other as far as its zoospore release is concerned. *G. indica* has also been cultured in different cultural conditions, viz., distilled water (DW), double-distilled water (DDW), de-ionized water (DIW), pond water (PW) and soil-extract water (SEW), to assess its stability and has been found to be stable with $\pm 5\%$ variations. Therefore, *Girishia indica* may logically be considered in the “connecting-link” position in between Pythiaceae and Saprolegniaceae.



Figs. 3 A-B: Oögonium with oöspore of *Pythium debaryanum* and *Girishia indica*.

- A: Completely filling the oögonium single plerotic oöspore of *Pythium debaryanum*.
 B: Completely filling the oögonium single eccentric oöspore of *Girishia indica*.

CONCLUSION

Girishia indica, newly described member of Saprolegniaceae, exhibits well defined reproductive phases and indicates certain typical characteristics of its own. Vegetative structures and development of reproductive stages shows its alliance with family Saprolegniaceae whereas the zoospore release from the zoosporangium has been typically identical to *Pythium* of family Pythiaceae. Therefore, *G. indica* has been considered in the “connecting-link” position in between Pythiaceae and Saprolegniaceae.

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