

Two species of *Herpomyces* (Laboulbeniomycetes: Herpomycetales) from India

SURINDER KAUR

Department of Botany, SGTB Khalsa College, University of Delhi, Delhi – 110007

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During our rigorous investigation on Laboulbeniomycetes from India, two species of genus *Herpomyces* on cockroaches (Hexapoda, Blattodea) are reported for the first time from this part of the world. These are *Herpomyces ectobiae* on *Blattella germanica* and *H. periplanetae* on *Periplaneta americana*. Comprehensive description along with photographs of these species is provided.

Key words: Ascomycota, perithecium, dioecious, antheridia

INTRODUCTION

The class Laboulbeniomycetes is comprised of three orders of obligately arthropod-associated fungi viz. Laboulbeniales, Herpomycetales, and Pyxidiophorales. Of these, Laboulbeniales and Herpomycetales do not form hyphae but instead form discrete microscopic and multicellular thalli. The specialized vegetative body of the fungus consists of definite or limited number of cells and show clear individuality. The order Laboulbeniales consists of obligate ectoparasites of arthropods. They remain on the surface of the animal for most of the time, penetrate its cuticle and absorb nutrition with an absorption cell called a haustorium. About 80% of the Laboulbeniales described so far are parasitic on the order Coleoptera (Weir and Blackwell 2005). Study of this group started in 1853 and over 2200 species in 142 genera are described till date, but many more species are still to be discovered (Haelewaters and Yaakop 2014; Reboleira *et al* 2018). Another unique feature among these ascomycetes is the absence of asexual reproduction. Order Herpomycetales includes a single genus, *Herpomyces* Thaxter., with 27 described species—all associated with cockroaches (Blattodea) (Haelewaters *et al.* 2019; Gutierrez *et al.* 2020). In the past years, reported many species of Laboulbeniomycetes have been reported from India. The present paper deals with two species of

Herpomyces, both of which are new to Indian mycoflora.

MATERIALS AND METHODS

The insects were collected from different habitats. These were killed and then preserved in 70% alcohol and then screened under binocular microscope for the presence of these fungi. The fungi were isolated with the help of needles and mounted in Hoyer's medium.

RESULTS AND DISCUSSION

Taxonomy

Herpomyces Thaxter, Mem. Amer. Acad. Arts Sci., **13**: 285, 1908

Herpomyces is a dioecious genus. It is mostly found on cockroaches (Hexapoda, Blattodea). Perithecium arises from a secondary receptacle derived from an outgrowth of a simple primary receptacle formed by the germinating spore, the latter more or less retaining its original identity and becoming essentially nonfunctional, the secondary receptacle often proliferating and forming successive perithecia; perithecia with nine tiers of wall cells, male individuals are small, with simple antheridia, known only on species of several families of cockroaches (Blattidae). About 25 species of this genus are known so far from various species of cockroaches

and two are reported during the present study. Pfliegler *et al* (2018) reviewed the currently known records of *Herpomyces*-associated cockroaches and host-parasite relationships, their study indicated that the distribution and host range of these obscure and often unnoticed fungi are affected by human activities.

Herpomyces ectobiae Thaxter, Proc. Amer. Acad. Arts Sci. **38**:20, 1902; Mem. Amer. Acad. Arts Sci. **13**: 289, 1908; **16**: 82, 1931, Majewski and Sugiyama, Trans. Mycol. Soc. Japan **26**:300, 1985 (Fig.1).

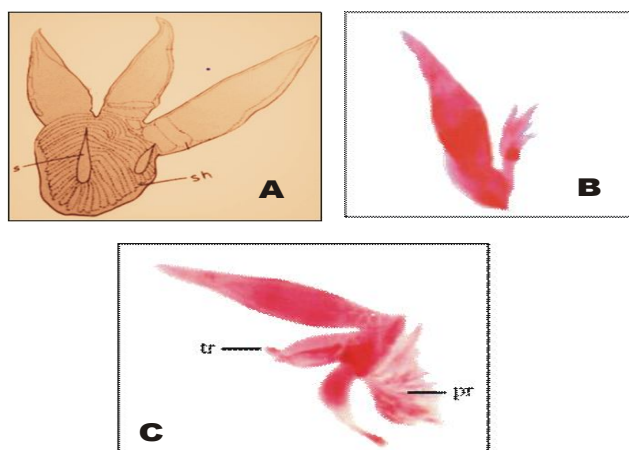


Fig. 1: *Herpomyces ectobiae* (A-C) A- Female thallus having three mature perithecia, with pointed tips, subtending them, a multicellular shield (sh) and seta (s) can be seen. B- Young female thallus; C- One mature and three young perithecia showing trichogyne (tr) and male individual showing primary receptacle (pr)

This species is found on the legs, antennae and other parts of the cockroach. There are typical truncate perithecia in the female thalli. Below the perithecia, is the small shield formed from the secondary receptacle cells. The male thallus is formed paired with the female and consists of a bunch of antheridia.

Male thallus is hyaline, usually consists of four superposed cells terminated by a blackish projection, the distal cell producing a dense appressed tuft of coherent antheridial branchlets and antheridia. The sub-basal cell of the primary receptacle usually give rise to a fertile, simple or furcate branch which produces secondary male receptacles consisting of short stalked, unilateral, dense antheridial tufts similar to the primary one.

Female thallus hyaline, consists of primary receptacle, secondary receptacle and perithecia. Primary

receptacle is cylindrical composed of four superposed cells, the basal cell attached to the host's surface by a small blackish foot, the sub-basal cell producing usually two branches of the secondary receptacle, which are up to 150–162.5 μm long, consisting of numerous elongated cells arranged obliquely Perithecia inflated below, tapering gradually towards a thin truncate apex, 112–125 μm long, 25–31.5 μm thick, many in number. In each thallus, one perithecium forms a full sized shield, while in the rest, a few rudimentary divisions result in small rudimentary shield for each.

Specimens examined: Delhi, DU/MSK/898, DU/MSK/899, DU/MSK/900, DU/MSK/901.

Remarks: This species has been isolated from *Blattella germanica* (Blattodea, Blattellidae) and was found on all parts of the host like antenna, anal cerci and legs with their base towards the base of the insect body part. It was earlier reported from Europe, Zanzibar, the Philippines, Japan, North, Central and South America and from India, this is the first report.

Herpomyces periplanetae Thaxter, Proc; Amer. Acad. Arts Sci. **38**:13, 1902; Mem. Amer. Acad. Arts Sci. **13**:285, 1908; **16**:86, 1931; Sugiyama, J. Jap. Bot. **53**:154, 1978; Sugiyama and Majewski, Trans. Mycol. Soc. Japan **26**:134, 1985 (Fig. 2).

The species is dioecious but the male thalli are not found paired with the female as in *H. ectobiae*. Male thallus is 62.5–87.5 μm long, consists of of superposed cells and many short branches and branchlets that bear simple elongated, conical antheridia on their tips.

Female thallus is 212.25–237.75 μm long, secondary receptacle is multicellular, forming a bilobed protective shield 37.5–43.75 x 62.5–68.75 μm . The shield has narrow, long cells arranged in a typical seriate manner. Perithecia two to five per thallus, slightly asymmetrical, 175–187.5x37.5–62.5 μm , tapering from the slightly inflated base to the not clearly differentiated distal portion, the apex slightly bent, subtended by a pointed tooth or beak like structure. The beak of the perithecia and the large shield are characters typical to this species and different from *H. ectobiae*.

Specimens examined: Delhi DU/MSK/890, DU/MSK/891; DU/MSK/893; DU/MSK/894; DU/MSK/895; DU/MSK/896; DU/MSK/817.

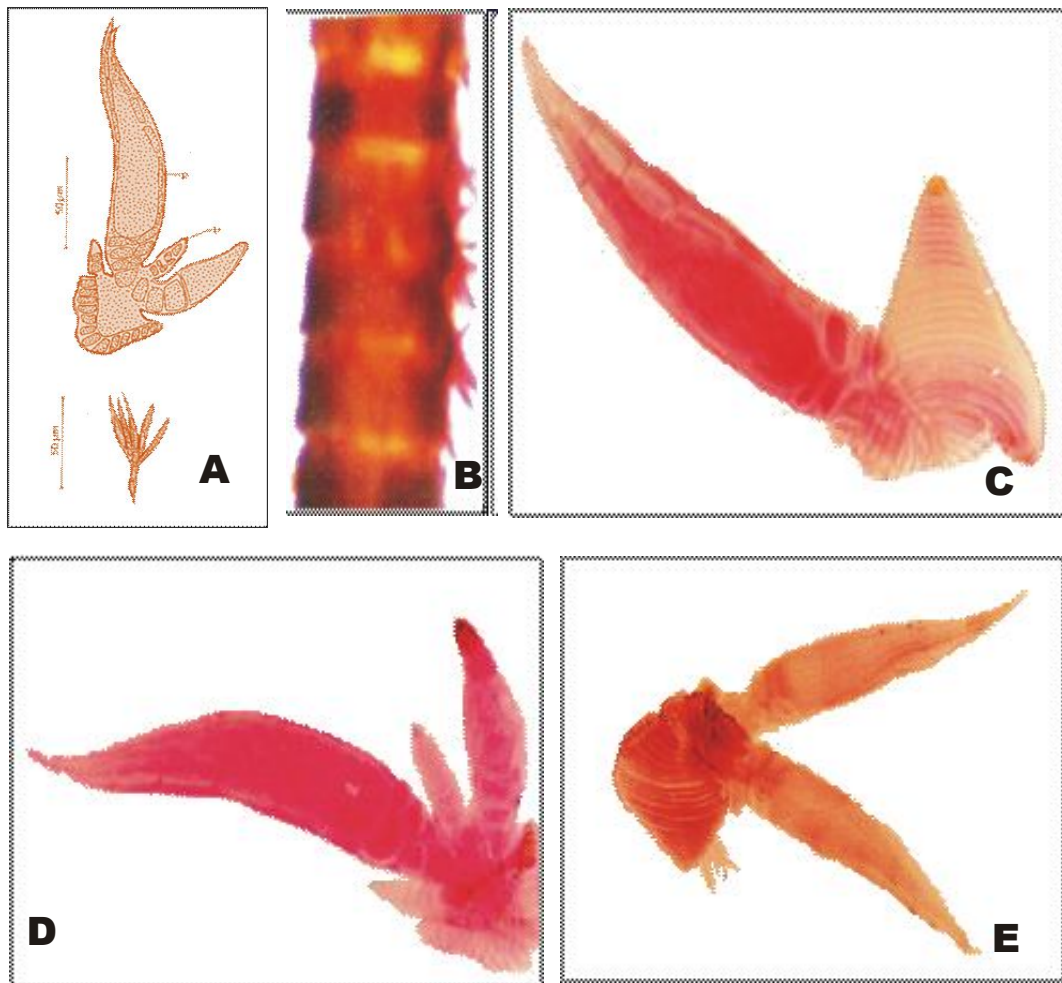


Fig. 2 : *Herpomyces periplanetae* (A-E). A-Female individual showing two young and two mature perithecia (p) (top) & male individual showing spermatia (bottom). B- On antenna of host. C- Female individual showing single perithecium having multicellular shield. D- Female individual showing one mature and three young perithecia. E- Two mature perithecia with cone shaped shield at the base

Remarks: The present species has been isolated from *Periplaneta americana* (Blattodea, Blattidae). The fungus is host specific to a very high degree, being specific about the position on the host as it was encountered only on the antennae of the host. The fungus resembles finger-like outgrowth on the antennae, It is totally hyaline, lacking even the black foot which is very characteristic of these fungi. The number of thalli per insect was indefinite. The female thalli were more as compared to the male. Usually several developmental stages were present, on some insect although in some thalli, all perithecia were found to be of same age. Another species, *Herpomyces chaetophilus* was reported on *Periplaneta americana* by Haelewaters *et al* (2017) from Panama and neighboring areas. It is different from the described species as it has solitary perithecium, the tip of which bends anteriorly and also it lacks shield at the base of the perithecium (Wang *et al* 2016).

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