

On the occurrence of epiphyllous Deuteromycetous fossil fungi *Palaeocercospora siwalikensis* Gen. et sp. nov. and *Palaeocolletotrichum graminoides* Gen. et sp. nov. from Neogene sediments of Darjeeling foothills, Eastern Himalaya

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Two Deuteromycetous epiphyllous fungi viz., *Palaeocercospora siwalikensis* Gen. et sp. nov. and *Palaeocolletotrichum graminoides* Gen. et sp. nov. on dicotyledonous and monocotyledonous leaf cuticles respectively are described from Siwalik Foredeep Basin of Darjeeling foothills, Eastern Himalaya. Affinity of the new taxa with extant genera and environment of the sediments recovering the taxa have been discussed

Key words: Fossil, endo- and ecto-parasites; Middle Miocene; Palaeoclimate

INTRODUCTION

Epiphyllous fungi on fossil angiosperms are very good indicators of palaeoclimate, rate of precipitation and overall ecosystem (Dilcher, 1965; Alvin and Muir, 1970; Daghlian, 1978; Lange, 1978; Taylor, 1994 and Banerjee, 1990, 1995). Recent studies of the cuticles of angiosperm leaves collected from Neogene sediments of Darjeeling foothills have recorded a rich assemblage of epiphyllous fungi both on dicotyledonous and monocotyledonous leaf cuticles. Earlier, dispersed fungal assemblage including microthyriaceous fungi has been described from the same sediments (Pathak and Banerjee, 1984). From the adjacent Siwalik Foredeep basin of Bhutan, Eastern Himalaya a rich assemblage of epiphyllous fungi has been recorded on cuticles comparable to leaf cuticles of modern mangrove plants (Banerjee, 1995).

MATERIALS AND METHODS

Some completely preserved and many fragmentary portions of dicotyledonous and monocotyledonous angiosperm plant leaves have been collected which have carbon layer preserved on the lamina. The fragmentary parts of the leaves have utilized for cuticular preparation of present study.

Location of collection of samples

The samples of present study are from Geobdat

Sandstone Formation exposed in the road section of NH31 near Mangpong village, Darjeeling district, West Bengal, India (Text-fig. 1). The geology & stratigraphy of location is given in Table 1.

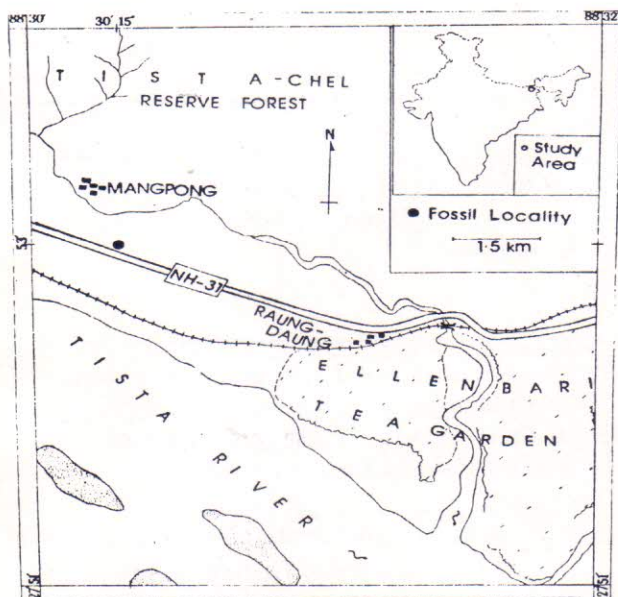
Table 1 : Geological and stratigraphic succession in the frontal zone of Eastern Himalaya (after Acharyya, 1994).

Darjeeling Foothill	Age of main unit and broad correlation
Damuda Fm.	Permian
—MBT— MBT—	
Chunabati Fm. (contain horses of damuda & slivers of earliest Miocene limestone)	Lower Siwalik Dhamasala (Miocene)
—Thrust— Thrust—	
Murti Boulder bed Prabhu giti Fm Geobdat sandstone Fm Gish clay Fm	Upper Siwalik Middle Siwalik Lower Siwalik (Neogene)
—Foothills Thrust—	

Alluvial stepped sediments of Ganga Brahmaputra Basin

The fragments with carbonized layer have been dipped

in Hydrofluoric Acid (HF) for 24. The cuticles dissociated from the rocks have been thoroughly washed and treated with 50% HNO₃ along with pinch of sodium chlorate crystal. Oxidised cuticular layers have been processed with (10% KOH) solution and washed thoroughly with distilled water. The cuticular layers with epiphyllous fungi thus recovered are mounted in euperol after proper dehydration or in glycerine jelly after keeping the materials in 50% glycerine.



Text-Fig. 1. Map showing collection sites of fossils on NH31 in Darjeeling district, West Bengal.

DIAGNOSIS AND SYSTEMIC DESCRIPTION

Palaeocercospora siwalikensis Gen. et sp. nov.

Subdivision	-	Deuteromycotina
Class	-	Hyphomycetes
Order	-	Moniliales
Family	-	Dematiaceae
Genus	-	<i>Palaeocercospora</i> nov.
Species	-	<i>siwalikensis</i> nov.

Palaeocercospora Gen. nov.

(Figs. 1-5 ; Text-Fig. 2)

Generic Diagnosis : Stroma compact, with groups of well developed hyphal cells, conidiophores occur singly or in fascicles of 2-7, elongated, divergent, septate, conidial scar present at the point of geniculation.

Specific Diagnosis : Stroma distinct, circular with undulated outline; fascicles of conidiophores ranging

7-20 in number emerge from peripheral zone of stroma. Conidiophores simple, thick walled, smooth, pluriseptate with conidial scar on each cell.

Type species : *Palaeocercospora siwalikensis* gen et. sp. nov.

Description :

The hyphomycetous epiphyllous fungi showing distinct, well developed stroma; stroma circular, 16.8 to 37.8/ μ m in diameter, consists of deep brown compactly arranged hyphal cells; conidiophores fasciculate, in fascicles of 7-20 divergent stalks emerging from the stroma. Light brown to dark brown in colour, straight to flexuous, simple, slightly thick walled, smooth, pluriseptate (5-7 septa), spore scar present and conspicuous, lying at the point of geniculations of the conidiophore; conidiophores long (42-92.4/ μ m) and slender (width 4.2-6.3/ μ m), tip somewhat pointed. Conidia absent.

Affinity : The extinct fungal form *Palaeocercospora siwalikensis* shows close resemblance with the extant taxa *Cercospora* Fresenius, and *Cercospora atlyosiae* Thirumalachar and Govindu (1953) in particular. Size and characteristics of stroma, 7-20 conidiophores in fascicles of 1-7, size, shape, septation pattern of conidiophores, number and positions of conidial scar of *P. siwalikensis* are closely comparable with the characteristics of the extant taxa *C. atlyosiae*. The type species of the extant form is reported as an epiphyllous taxa *Atlyosia villosa* Benth. of Fabaceae. Recently De (1991) has reported *C. atlyosiae* on same leaf as leaf spot from lower Bengal. Antal and Awasthi (1993) described fossil leaf *Bauhinia ramthiensis*, *Cynometra tertiara*, *Albizia palaeolebbek*, *Pongamia siwalika*, *Entada palaeoscandens* with affinity to Fabaceae family from Neogene sediments of Darjeeling foot hills. A few completely preserved fossil specimens in the collection of present authors have been assigned to Fabaceae.

Holotype Slide No. : DR-EF (1)

Location : Darjeeling foot hills NH31 Road Section

Horizon : Geabdat Sandstone Formation, Middle Miocene.

Repository : Palaeobotany-Palynology Laboratory, Department. of Botony , University of Calcutta.

Palaeocolletotrichum graminoides Gen et. sp. nov.

Subdivision - Deuteromycotina

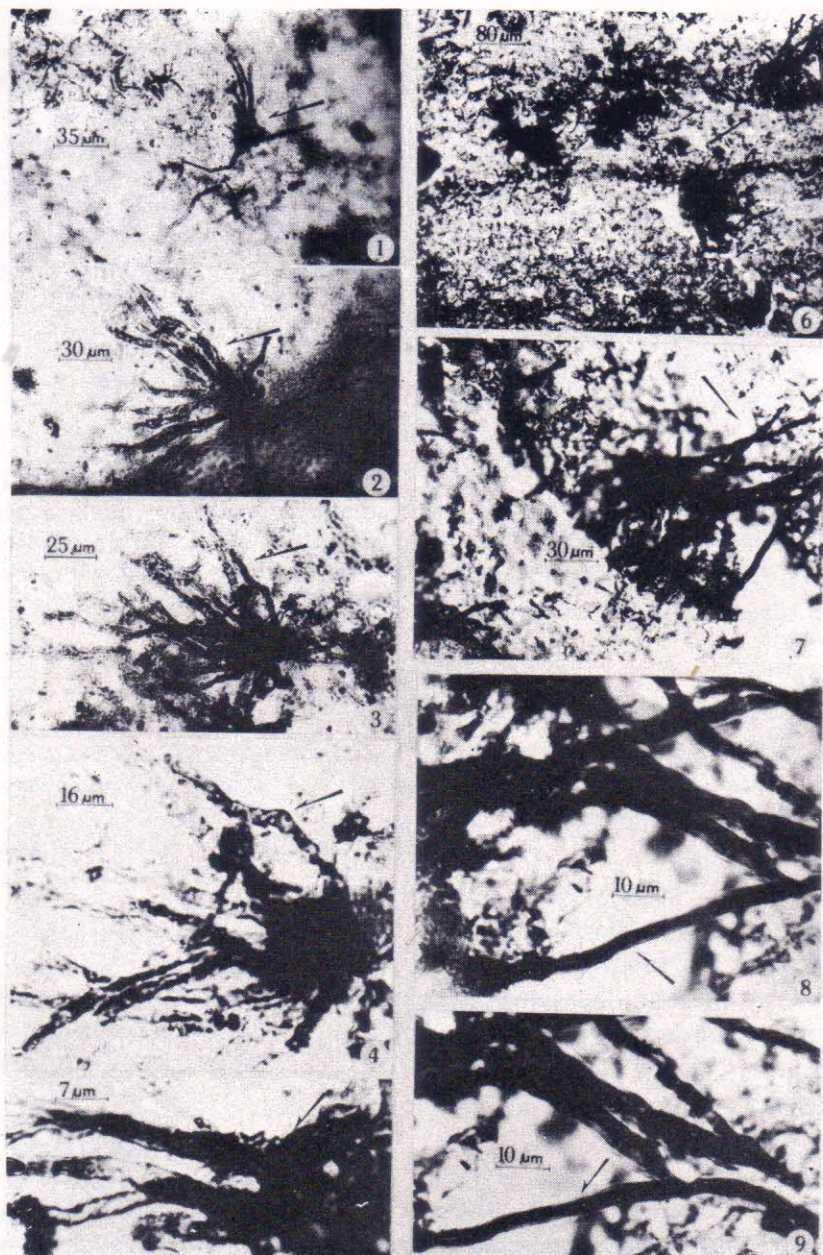


Fig. 1. *Palaeocercospora siwalikensis* Gen. et sp. nov., epiphyllous fungal body on dicotyledonous leaf cuticle from Geabdat Sandstone Formation, Siwaliks, E. Himalaya. SI. No. DR-EF (1); (x300); Fig. 2. *P. siwalikensis* showing fascicles of conidiophores. SI.No. DR.-EF (1); (x350); Fig. 3. *P. siwalikensis*; SI. No. DR-EF (1); (x400); Fig. 4. Magnified view of the conidiophores of Fig. 3. showing conidial scars at the points of geniculation. SI. No. DR-EF (1); (x600); Fig. 5. Magnified view of *P. siwalikensis* showing compact stroma and fascicle of conidiophores. SI. No. DR-EF (1); (x1600); Fig. 6. *Palaeocolletotrichum graminoides* Gen. et sp. nov, epiphyllous fungi in linear rows on monocotyledonous leaf cuticle from Geabdat Sandstone Formation, Siwaliks, E.Himalaya. SI. No. DR-EF (2); (x125); Fig. 7. Subdermal acervulus and projecting setae of Fig 6 (arrow - marked) magnified. SI. No. DR-EF (2): (x 330); Fig. 8-9. Magnified views of Fig. 7 showing septate and apically pointed setae with bulbous base impregnated in the acervular mass. SI. No. DR-EF (2) : (x1000).

- Class - Coelomycetes
 Order - Melanconiales
 Family - Melanconiaceae
 Genus - *Palaeocolletotrichum* nov.
 Species - *graminioides* nov.

***Palaeocolletotrichum* Gen. nov.**

(Figs. 6-9 ; Text-figs.3)

Generic Diagnosis : Subdermal acervuli indistinct, long narrow stiff, pointed setae emerging from the acervular surface.

Specific Diagnosis : Setae isolated or in cluster of 3-6, long, base bulbous, pointed at the tip, septate, smooth.

Type Species : *Palaeocolletotrichum graminioides* Gen et. sp. nov.

Description : The Coelomycetous epiphyllous fungi remains occur on cuticular layers show numerous setae scattered singly or in groups of 3-6 both on veins and interveinal regions. Faint outline of hyphal mass of acervular structure observed in the subepidermal position.

Individual setae 84-126µm long, stiff, pointed, moderately thick (4µm - 5.5µm), dark brown in colour, projected out from the leaf surfaces. The projected setae with a bulbous base of 7-8.4µm in diameter, septate, number of septa varies from 5-8.

Affinity : The fossil epiphyllous fungi *Palaeocolletotrichum graminioides* Gen. et. sp. nov. shows well preserved setae with subdermal acervulas. The taxa resembles the extant epiphyllous fungi *Colletotrichum* Corda which is known to occur as endoparasite on monocotyledonous plants in addition to dicotyledonous plants; Alexopoulos *et al.*, 1996; Singh, 1982;).

Holotype Slide No. DR-EF (2)

Location : Darjeeling Foot hills NH31 Road Section

Horizon : Geabdat Sandstone Formation, Middle Miocene.

Repository : Palaeobotany-Palynology Laboratory, Department. of Botony , University of Calcutta.

DISCUSSION AND CONCLUSION

Records of *Palaeocercospora siwalikensis* and *Palaeocolletotrichum graminioides* reveal that the ectoparasitic and endoparasitic epiphyllous fungi occurred on the leaves of both dicotyledonous and monocotyledonous host plants of the forests of Neogene period. The epiphyllous fungi are indicators of

temperate-tropical warm, humid climate (Dilcher, 1965). The earlier records of dispersed fungal spores of tropical humid climate (Pathak and Banerjee, 1984), pinnately compound foliage shoot of. estuarine *Nypa* palm (Banerjee *et al.*, 1998), Palynomorphs of tropical, humid, near-coastal environment (Mitra *et al.*, 1999) from the Geabdat Sandstone Formation of Neogene sediments of Darjeeling foot hills and occurrence of fungi on leaf cuticles of. mangorve plants form the adjacent Neogene sediments of Bhutan Siwaliks (Banerjee, 1995) strongly suggest tropical, humid palaeoclimate for the pesently described epiphyllous fungi.

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