

# ON A NEW MONOCOT AXIS WITH PATHOGENIC FUNGI FROM THE DECCAN INTERTRAPPEAN BEDS OF INDIA

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## ABSTRACT

A new fossil monocotyledonous grass axis with fungal infection of *Tilletia*-like spores is described. This is the first record of infected graminaceous axis from the Deccan Intertrappean beds of India. A new species *Culmites deccanensis* sp. nov. and a new genus *Chlamydosporites* with a new species *C. gramineum* is instituted.

## INTRODUCTION

From the Deccan Intertrappean exposures of India, many fossil parasitic fungi have been reported from time to time. These are fruit bodies recorded by SAHNI AND RAO (1943); Teleutospores by DWIVEDI (1959); *Diplodia*-like fungus by MAHABALE (1969); *Helminthosporium*-like fungus in an infected grain by CHITALEY AND SHEIKH (1969, 1971); Deuteromycetous fungus in a wood by CHITALEY AND PATIL (1971); and *Tetracosporium* in a wood by MAHABALE AND BIRADAR (1971).

Occurrence of fungal flora in the Intertrappean cherts is not surprising. The humid and warm climatic conditions of the Deccan Trap period favoured the growth of saprophytic and parasitic fungi. The fungus described in this paper is an addition to the fungal flora from these beds. It is occurring in a small piece of monocot axis surrounded by leaf sheaths. In both transverse and longitudinal sections the fungus was studied with the host, by taking peel sections of the chert.

Genus **Culmites** Brongniart (1922)

**Culmites deccanensis** sp. nov. (Pl. 1, Fig. 5)

*Diagnosis*: Culm 1.5 cm long and  $2 \times 1.3$  mm broad, showing scattered vascular bundles; bundles collateral, endarch, closed; leaf sheaths and culm together,  $8 \times 5$  mm broad; bundles of sheath of same size and similar to those of culm with sclerenchyma sheaths all round near the peripheral part of the stem and dorsal and ventral sclerenchyma cap in the central region; vascular tissues not preserved or absent.

*Holotype*—CGr 1/P, Department of Botany, Institute of Science; Nagpur.

*Horizon*—Deccan Intertrappean Series.

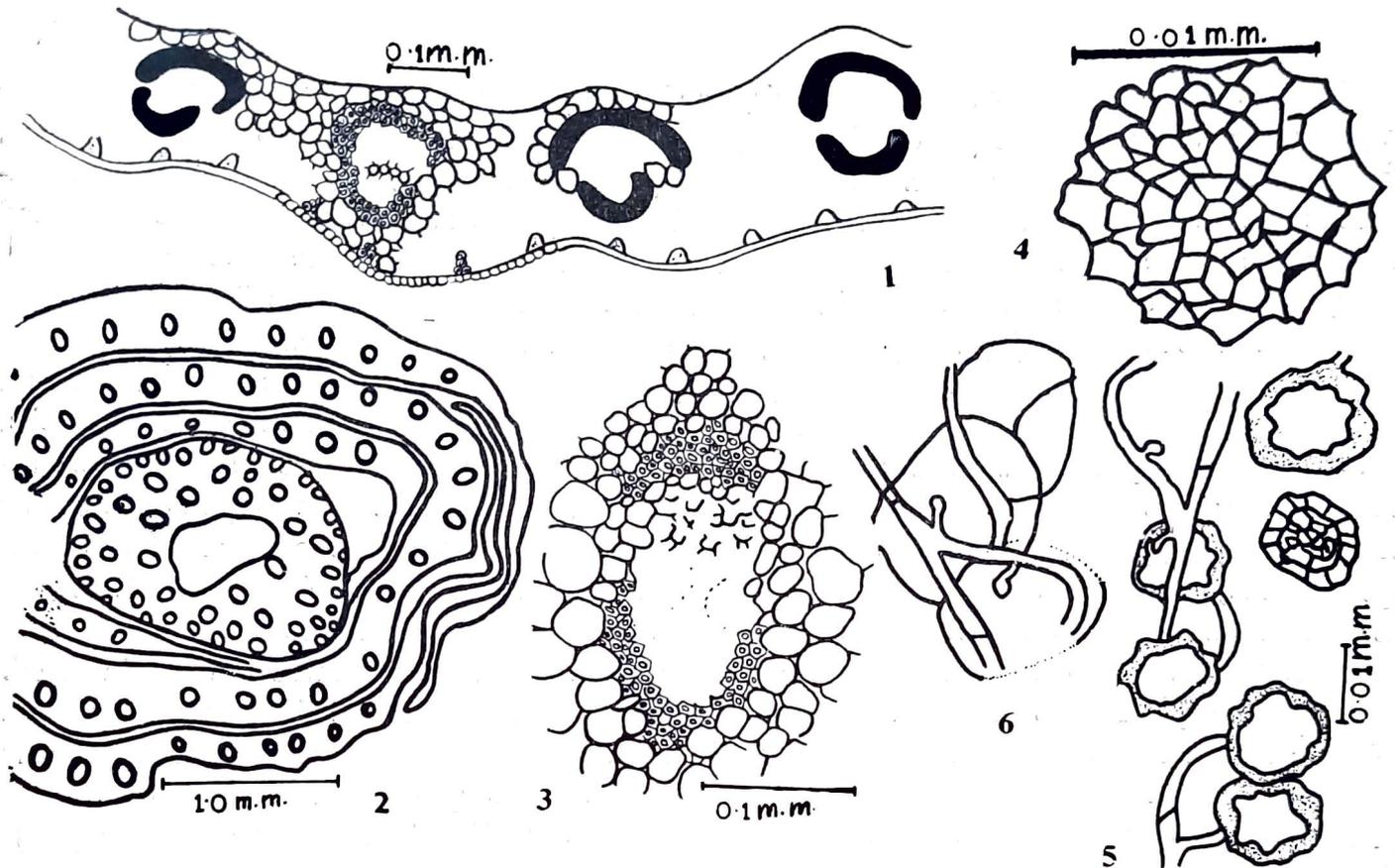
*Locality*—Mohgaon Kalan, District Chhindwara, M. P., India.

*Age*—?Upper Cretaceous.

## DESCRIPTION

The culm is 1.5 cm long and  $2 \times 1.3$  mm broad. It is oblong in T.S. and surrounded by leaf-sheaths seen with naked eye. Entire culm with the surrounding leaf-sheaths is  $8 \times 5$  mm thick oblong and hollow. Such hollow cylinders are characteristic of most of the grasses. The diameter of the hollow centre is  $0.9 \times 0.5$  mm in relation to the total  $2 \times 1.3$  mm

diameter of the culm. A transverse section shows that the culm is built up essentially of a ground tissue (Text-fig. 2; Pl. 1, figs. 1, 5). At the peripheral part of the culm thick walled mechanical tissues (Pl. 1, fig. 1) are developed to the greatest extent forming a continuous layer in which the smaller vascular bundles are embedded (Text-fig. 2; Pl. 1, figs. 1, 5). The inner ground tissue consists of large thin walled parenchymatous cells (Pl. 1, fig. 2). The transition between the thick-walled peripheral tissue and the inner parenchymatous tissue is gradual.



Text-figs. 1-6. 1, T.S. leaf sheath showing vascular bundles and mesophyll.  
 2, T.S. hollow culm and leaf sheaths. Scattered vascular bundles seen in the culm.  
 3, Single vascular bundle showing sclerenchyma sheath and disintegrated conducting tissues.  
 4, Reticulate chlamydospore enlarged.  
 5 & 6, Mycelium and hyphae with haustoria and chlamydospores.

Vascular bundles are scattered (Text-fig. 2; Pl. 1, figs. 1, 5) as in other monocot stems. Those nearest the central cavity are larger than the bundles at the periphery (Pl. 1, fig. 1). Individual bundles in outer region are rounded and larger ones in central part are oblong to elliptical in shape. Each vascular bundle has sclerenchymatous sheath all round in the outer regions of the culm. The inner bundles have only dorsal and ventral sheaths. The vascular bundles are collateral, closed with centrifugal phloem. The phloem is of sieve tubes and phloem parenchyma, not clear in all the bundles. Xylem elements are also not clearly noted (Pl. 1, figs. 2, 3, 5). In many cases the cavity formed by the disintegration of xylem is occupied by fungal hyphae (Pl. 1, fig. 3). In the leaf-sheaths the vascular bundles are made up of the sclerenchymatous sheaths.

The leaf-sheath forms a complete covering around the stem or culm with the ends overlapping (Text-fig. 2). There are about two or three rounds of this sheath. Each leaf-sheath is 270-285  $\mu$  in thickness in its broadest part and becomes gradually thinner at the overlapping ends. The leaf-sheath shows abaxial smaller epidermal cells with thick outer walls (Text-fig. 1). The adaxial epidermis is of a uniform layer of large, thin walled cells. The

vascular bundles are of the same size (Text-fig. 1), and are distinguished by the sclerenchymatous sheaths with disintegrated vascular tissue. Inside the abaxial epidermis there are hypodermal groups of sclerenchymatous cells giving mechanical support to the leaf. These are separate from the bundle sheaths and are not connected to them (Text-fig. 1). The mesophyll is of thin walled parenchymatous cells. Stomata could not be definitely observed on the leaf-sheath.

## COMPARISON

The general structure of the small axis, its size and the sheaths surrounding it indicate a grass-like nature for this plant. However, details of the vascular bundles being not clear, further identification is difficult. As METCALFE (1960) has stated, similarity of culm structure is not necessarily an indication of taxonomic affinity and sections of culm are of limited taxonomic value. The characters, circumvascular sclerenchyma, bundle sheaths, bulliform cells, ribs and furrows on the adaxial surface, were tried without success for further identification. The culm may perhaps belong to an extinct species of grass.

*Culmites cutchense* described by SAHNI (1964) is 1.5 cm thick with nodes and internodes, rhizome and dormant ovate-plano-convex buds and with sinuous-walled epidermal cells, 500-550 stomata per mm square on the aerial stem. It is, thus, much different from the present thinner axis belonging to Gramineae rather than Cyperaceae. The Cyperaceae shows stellate ground parenchyma while the present axis shows simple parenchyma. The present specimen is, therefore, assigned to the form genus *Culmites* Brongniart (1822) and is named as *Culmites deccanensis* sp. nov. The specific name is after the region Deccan.

It is interesting to note the fungal infection of the culm. Leaf-sheaths are not infected. The fungal mycelium is of septate hyphae developed profusely in the intercellular spaces of the ground tissue. Haustoria are clear (Text-fig. 5). Each hypha is 4-6  $\mu$  broad and is much branched. Associated with this mycelium are small spores. Each spore is 10-12  $\mu$  in size with thick reticulate wall. Inner membrane is thin (Text-fig. 6; Pl. 1, fig. 4). These spores seem to be oidia. Other growth stages of spores are sexual, gametangia are not seen. The presence of haustoria indicates the parasitic nature of the fungus. This fact along with branched septate mycelium and the asexual spores help to identify this fungus as the Basidiomycetes. Ustilaginous fungi show such chlamydospore formation in many grasses and sedges. The fungus was, therefore, compared with modern genera of the Ustilaginales like, *Ustilago*, *Spacelotheca*, *Tolyposporium*, *Neovussia*, *Urocystis*, *Emphylloma* and *Tilletia*. Out of these it compares well with the chlamydospores of *Tilletia* in size and spore ornamentation (GREGORY, 1973). Since only the chlamydospore stage is observed here without any sexual stage, the fungus is named as *Chlamydosporites gramineum* gen. et sp. nov., the specific name is after the graminaceous host.

Genus ***Chlamydosporites*** gen. nov.

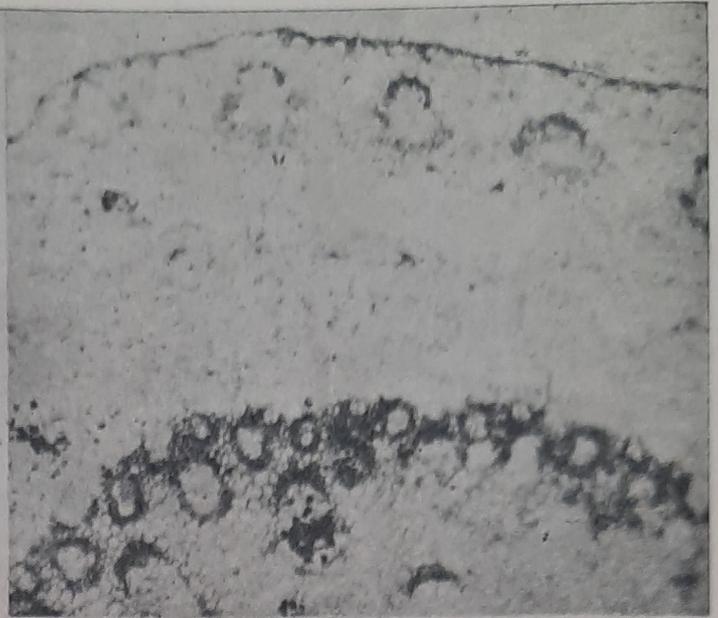
*Diagnosis*—Mycelium of septate branched hyphae with haustoria, chlamydospores with thick wall.

***Chlamydosporites gramineum*** sp. nov. (Pl. 1, Fig. 4)

*Diagnosis*—Mycelium profusely branched hyphae, septate, 4-6  $\mu$  broad, with haustoria, chlamydospores, 10-12  $\mu$  thick with reticulate exine and thin intine.

*Holotype*—F3P, Department of Botany, Institute of Science, Nagpur.

*Horizon*—Deccan Intertrappean Series.



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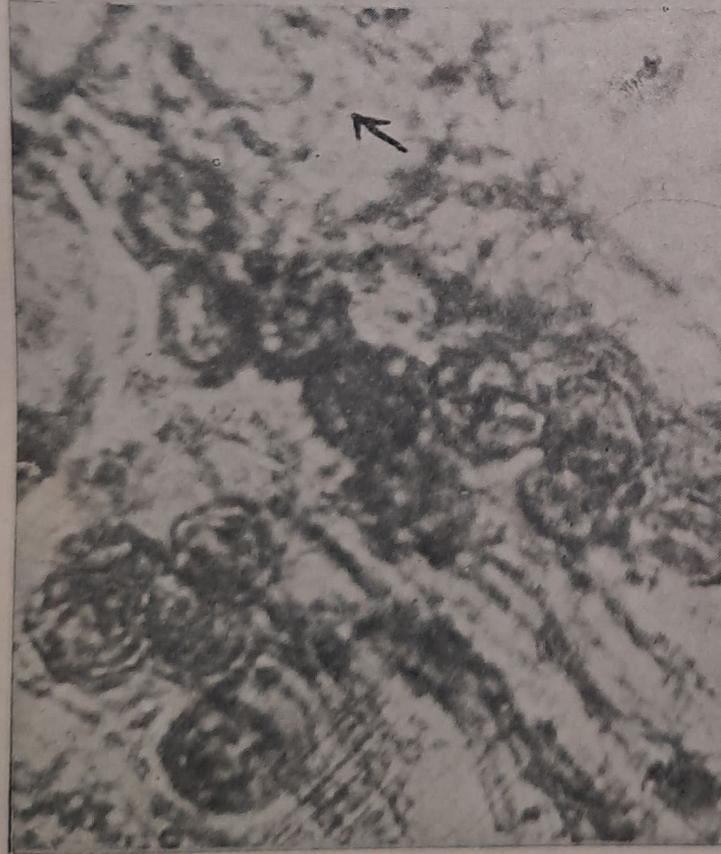


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Locality—Mohagaon Kalan, District Chhindwara, M. P., India.  
Age— ?Upper Cretaceous.

#### ACKNOWLEDGEMENT

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#### EXPLANATION OF PLATE-1

*Culmites deccanensis* sp. nov.

1. Part of T. S. culm enlarged to show outer smaller and inner larger bundles and sheath.  $\times 100$ .
2. A single inner bundle. Absence of vascular tissues is noted.  $\times 150$ .
3. Fungal mycelia (marked by arrow) seen in bundle cavities and others tissues.  $\times 150$ .
5. T. S. culm and sheath.  $\times 50$ .

*Chlamydosporites gramineum* gen. et sp. nov.

4. Chlamydospores and hyphae (see arrow) enlarged.  $\times 1000$ .