

Uncinioxylon mahabalei gen. et sp. nov., a cyperaceous rhizome from the Deccan Intertrappean beds of Wardha District, Maharashtra, India

Kalpana R. Datar and K. S. Patil†

Botany Department, Willingdon College, Sangli, 416 416, Maharashtra, India

†Botany Department, Smt. K. W. College, Sangli, 416 416, Maharashtra, India

Datar KR & Patil KS, 2008. *Uncinioxylon mahabalei* gen. et sp. nov., a cyperaceous rhizome from the Deccan Intertrappean beds of Wardha District, Maharashtra, India, *Geophytology* 37 : 93-98.

Uncinioxylon mahabalei gen. et sp. nov., a permineralized rhizome of Cyperaceae has been described from the Deccan Intertrappean beds, exposed at Nawargaon, Wardha District, Maharashtra. The rhizome is attached with roots and covered with leaf sheaths, lunar to sub-circular in transverse outline. The vascular cylinder consists of collateral, amphivasal vascular bundles and endodermoid layer. The anatomical features reveal its close resemblance with genus *Uncinia* of the family Cyperaceae.

Key-words – *Uncinioxylon*, Rhizome, Cyperaceae, Deccan Intertrappean beds, Maastrichtian-Danian.

INTRODUCTION

DECCAN intertrappean exposures of Nawargaon (21°1' N : 78°35' E) are quite rich in dicotyledonous and monocotyledonous remains (Bande, 1987; Bonde, 2008). The age of Deccan Intertrappean ranges from Maastrichtian to Danian (Guleria & Srivastava, 2001, p.19; Keller *et al.*, 2009). The present paper deals with a permineralized cyperaceous rhizome with roots and leaf sheaths. Cyperaceous remains known so far from the Deccan Intertrappean beds of India are *Scirpus*- like stem from Deccan Intertrappean beds of Bombay (Carter, 1852) *Cyperaceoxylon intertrappeum* Chitale and Patel (1970) from Mohgaonkalan, *Scirpusoxylon indicum* Shete (1989) from Nawargaon-Maragsur area and a fruit *Cyperaceocarpon sahnii* Dutta and Ambwani (2005) from Mohgaonkalan, Madhya Pradesh.

SYSTEMATIC DESCRIPTION

Family – Cyperaceae

Genus – *Uncinioxylon* gen. nov.

Uncinioxylon mahabalei gen. et sp. nov.

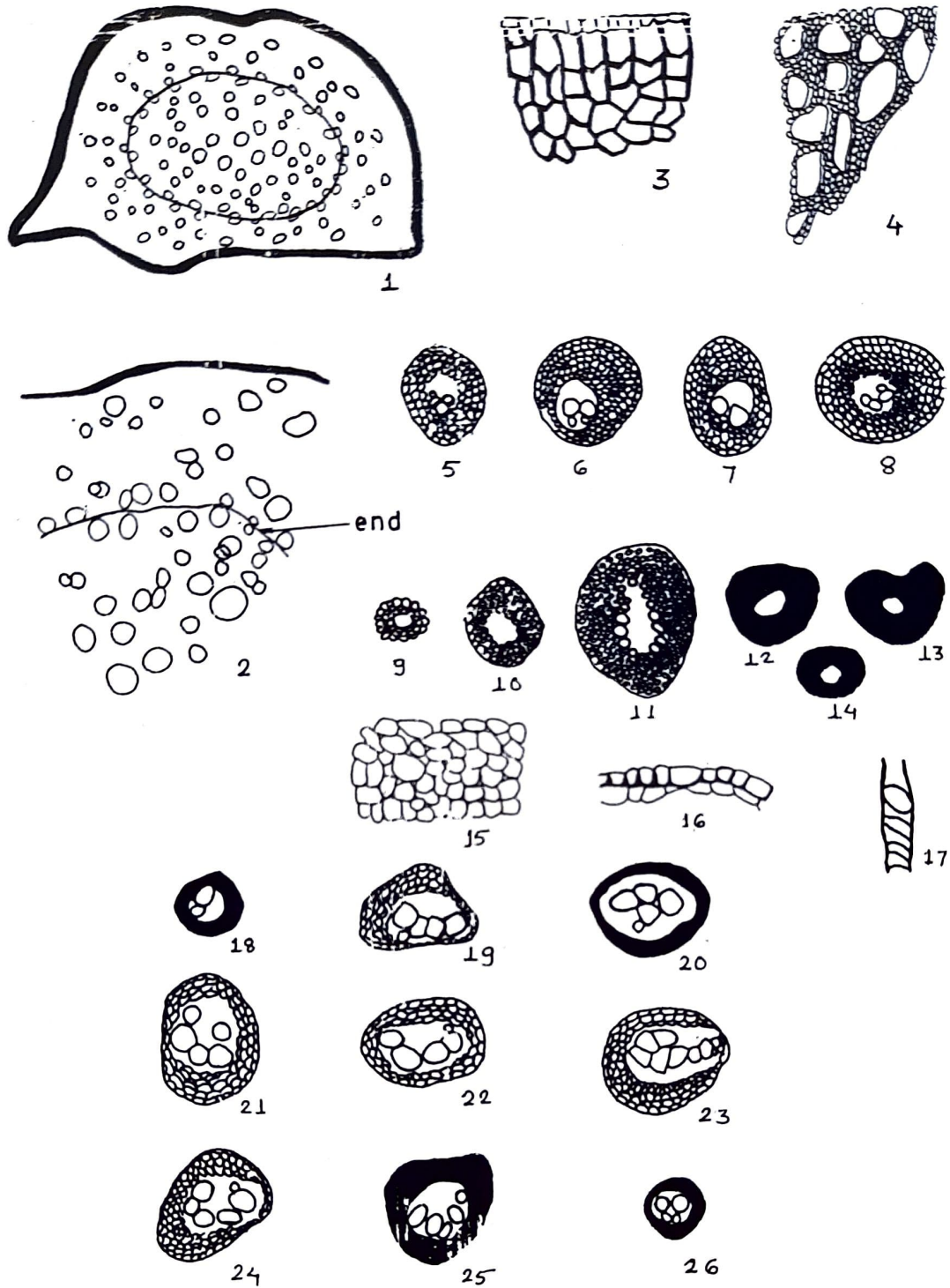
(Pl. 1, Figs 1-11; Text-Figs 1-44)

The specimen is a small permineralized piece of rhizome with roots and leaf sheaths. It is subcircular to lunar in transverse outline, 4.2 cms long and 1.2 cms in diameter. It has scars of roots. The rhizome is lunar to sub circular in transverse outline and surrounded by 2-4 leaf sheaths and two roots cut in various planes (Pl. 1 Fig. 1; Text-Fig. 1). *Epidermis* is made up of thick walled cells and is preserved only at few places (Text-Fig. 3). *Hypodermis* is sclerenchymatous (Text-Fig. 3) 8-

10 cells in thickness, cells thick walled, polygonal in shape with granular content in some of the cells. *Cortex* is aerenchymatous, 6 - 7 mm wide, lacunar with loosely arranged cells, 56-60µm forming large air cavities (Pl-1, Fig 4; Text-Fig. 4). The cortical vascular bundles are arranged in two rings (Pl. 1, Figs 4, 6; Text-Figs 1, 2), one contiguous to hypodermis and the other just above the endodermoid layer. A few vascular strands are scattered in the ground tissue. *Vascular bundles* oval to round in shape. They are collateral (Text-Figs 5-8) and amphivasal (Text-Figs 9-14) and possesses 3-4 xylem elements. Inner boundary of the cortex is delimited by an endodermoid layer made up of rectangular or isodimetric, 16-28 x 16 µm cells (Pl. 1, Figs 4, 5, 7; Text-Figs 2, 16). Vascular bundles in the peripheral zone of the central vascular cylinder are smaller and those in central zone are larger in size (Pl. 1, Figs 4, 7; Text-Fig. 2). Collateral vascular bundles are oval to round with 3-4 metaxylem and 1-2 protoxylem elements with annular thickenings (Pl. 1, Fig. 8; Text-Figs 17-26). *Conjunctive tissue* is thin walled (Text-Fig. 15).

Leaf Sheaths–The rhizome is ensheathed with 2-4 leaves (Pl. 1, Figs 1, 2; Text-Figs 27-32). Each *leaf sheath* embodies an adaxial epidermis with thick walled cutinized outer walls. *Hypodermis* has not been observed. *Mesophyll* tissue is parenchymatous with large air cavities (Text-Fig. 28). *Vascular bundles* are small to large in size and oval to round in shape, arranged in a single row. Smaller vascular bundles are amphivasal while larger ones are collateral. The collateral vascular bundles extend from adaxial epidermis to abaxial epidermis (Text-Figs 28, 29). The vascular tissue is enclosed in 3-4 layered sclerenchymatous sheath (Pl. 1, Fig. 3; Text-Figs

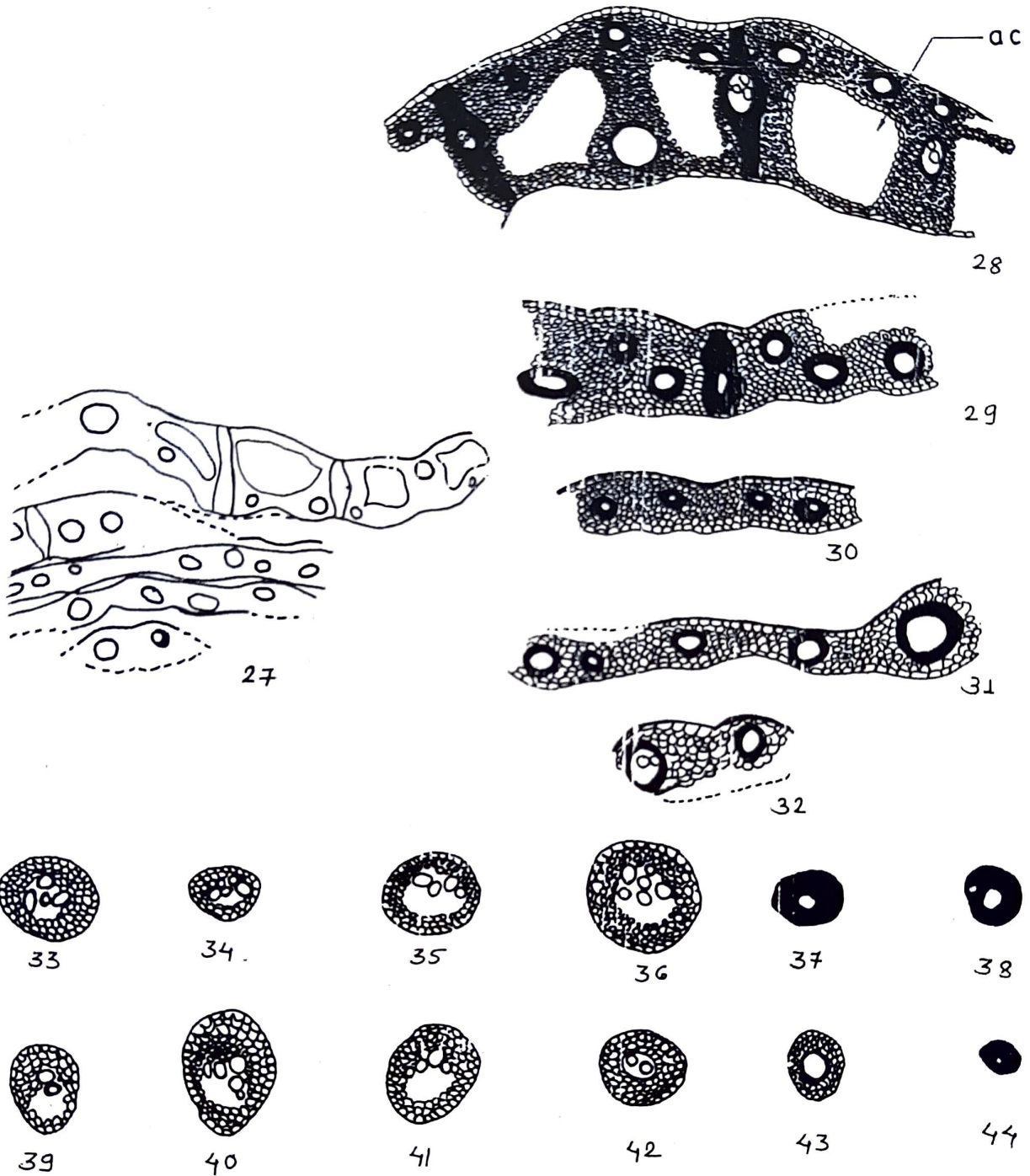
† Deceased (Nov., 2007)



Text - Figs 1-26

Uncinioxylon mahabalei gen. et sp. nov.

1. T.S. of rhizome showing the arrangement of vascular bundles and endodermal layer. x 6. 2. Sector of rhizome showing the arrangement of vascular bundles in cortical and central vascular zone and the endodermoid layer. x 25. 3. Single layered epidermis and thick walled sclerenchymatous hypodermis. x 100. 4. Part of cortex showing air cavities x 200. 5-8. Collateral vascular bundles with sclerenchymatous bundle sheath in the cortical region. x100. 9-14. Amphivasal vascular bundles in the cortical region. x 100. 15. Conjunctive parenchyma cells. x100. 16. Endodermis. Note the thickened radial and inner walls. x 100. 17. Xylem vessel with annular thickening in L.S. x 100. 18-26. Collateral vascular bundles in the central vascular region. x 100.



Text - Figs 27-44

Uncinioxylon mahabalei gen. et sp. nov.

27. Successive leaf sheaths adpressed to each other. x 25. 28. Innermost leaf sheath showing single row of vascular bundles, air cavities- ac and vascular bundles extending from adaxial to abaxial epidermis. x 50. 29. Part of next to innermost second leaf sheath showing single row of vascular bundles and one vascular bundle extending from adaxial to abaxial epidermis. x 50. 30. Third leaf sheath showing single row of vascular bundles. x 50. 31. Fourth leaf sheath showing single row of vascular bundles. x 50. 32. Outermost leaf sheath. x50. 33-36 and 39-42. Large collateral vascular bundles in the leaf sheath. x 100. 37, 38, 43, 44. Small amphivasal vascular bundles in the leaf sheath. x 100.

33-44). There are 3-4 xylem vessels. Abaxial epidermis is single layered.

Roots—Emerging from rhizome, there are roots, which are cut in various planes (Pl. 1, Figs 9, 10). They are 1296 x 1260 - 1440 x 954 μm in size. *Rhizodermis* is single layered made up of thick walled cells (Pl. 1, Fig. 11). *Cortex* the outer cortex is 3-4 layered with polygonal to rectangular parenchymatous cells. Inner cortical part is not preserved. *Endodermis* is single layered composed of thick walled cells. *Pericycle* is not preserved. Xylem elements in the stele exhibit annular thickenings. *Phloem bundles* not preserved and are represented by cavities.

COMPARISON AND DISCUSSION

Rhizome with leaf sheaths and roots, triangular to subcircular in cross sectional view; cortex with radiating air cavities, vascular bundles collateral and amphivasal; cortex delimited from the central vascular cylinder by an endodermoid layer; vascular bundles collateral and amphivasal; peripheral smaller than the central ones, vascular tissue with 3-4 metaxylem elements with annular thickenings. Leaf sheath with lacunar mesophyll; vascular bundles arranged in a row; larger and smaller bundles alternate to one another. Root with thick walled rhizodermis, lacunose cortex and xylem vessels with annular thickenings are the diagnostic characters of the present axis, suggesting its affinity with Cyperaceae.

The anatomy of several members of Cyperaceae has been studied by Holttum (1948), Kern (1962), Mora (1960), Kukkonen (1967), Koyama (1956, 1960, 1961, 1965, 1966, 1967), Govindrajalu (1966, 1969, 1969a). The studies have been summarized by Metcalfe (1969, 1971). There are 98 genera in Cyperaceae (Mabberley, 1997) of which only 34 possess rhizomatous stem. Cortical vascular bundles and endodermoid layer have been noted in *Uncinia*, *Machaerina*, *Fimbristylis*, *Eleocharis* and *Cyperus*. However, *Machaerina*, *Cyperus alternifolius*, *C. compressus*, *C. iria* and *C. tuberosus* only possess amphivasal vascular bundles whereas in the present fossil both collateral and amphivasal vascular bundles are present. In *Fimbristylis* vascular bundles in the stele are amphivasal and collateral in the cortex, whereas in the present fossil collateral vascular bundles are present in the stele. In *Eleocharis*, vascular tissue is fused and vessel elements are with tails, which are absent in the present fossil. In *Cyperus longus* vascular bundles are distributed regularly and not surrounded by sclerenchyma. It has been found that genus

Uncinia shows best resemblance. The fossil closely resembles *Uncinia compacta* due to the presence of endodermoid layer, cortex with collateral and amphivasal vascular bundles, collateral vascular bundles in the stele and xylem with annular thickenings.

Comparison with fossils

Cyperaceoxylon intertrappeum Chitale and Patel (1970) is a permineralized axis reported from Deccan Intertrappean beds of Mohgaonkalan. It differs from the present fossil due to lack of internal differentiation into the cortex, vascular cylinder and endodermoid layer. *Scirpusoxylon indicum* Shete (1986) is a rhizome described from the Nawargaon- Maragsur area from where the present fossil is reported. However, it differs from the present fossil in the absence of vascular bundles in cortical region.

Since the fossil shows resemblance with the extant genus *Uncinia* Pers., it has accordingly been named as *Uncinioxylon mahabalei* gen. et sp. nov. The specific name is in the honour of late Prof. T.S. Mahabale, a well known palaeobotanist. The genus *Uncinia* consists of 54 species and is mostly confined to Malaysia; south Indian Ocean, New Guinea, Australia, New-Zealand, Mexico and Venezuela to South America (Mabberley, 1997, p. 737).

GENERIC DIAGNOSIS

Uncinioxylon gen. nov.

Permineralized rhizome with roots and leaf sheaths; lunar to subcircular in transverse outline. Cortex with collateral and amphivasal vascular bundles, central vascular cylinder separated by endodermoid layer. Leaf sheaths with vascular bundles arranged in a row with alternate arrangement of collateral bundles.

Genotype-*Uncinioxylon mahabalei* gen. nov.

SPECIFIC DIAGNOSIS

Uncinioxylon mahabalei gen. et sp. nov.

Permineralized rhizome with roots and leaf sheaths. Rhizome lunar to sub circular in transverse outline. Hypodermis 8-10 cells, cortex 6-7 mm wide. Large air cavities present. Vascular bundles collateral and amphivasal. Vascular bundle surrounded by 5-6 layered or 40 μm thick sclerenchymatous sheath. Xylem elements 12-20 μm .

PLATE-1

Uncinioxylon mahabalei gen. et sp. nov.

Fig. 1. Cross section of rhizome showing the leaf sheaths. x 4, depicting lunar to subcircular shape. Fig. 2. Cross section showing the leaf sheaths. x 67. Fig. 3. Cross Section showing the vascular bundles in the leaf sheaths. x 134. Fig. 4. Cross Section showing the cortex - cor with cortical vascular bundles-- cvb, endodermis- end and central vascular zone. x 67. Fig. 5. Cross Section showing the endodermis. Note the thickened inner and radial walls. x 268. Fig. 6. Cross Section showing the endodermis and vascular bundles in cortex. Note the sclerenchymatous bundle sheath- sbs. x 134. Fig. 7. Cross Section showing the endodermis - end and inner small vascular bundles-vb from vascular zone. x 134. Fig. 8. Cross Section showing vascular bundles with thick sclerenchymatous bundle sheath and 3- 4 metaxylem elements. x 134. Fig. 9. Cross section of the rhizome showing a single obliquely cut root - r. x 5. Fig. 10. Same magnified showing obliquely cut steler part of the root. x 63. Fig. 11. Same magnified showing thick walled epiblema - epb of the root. x 267.

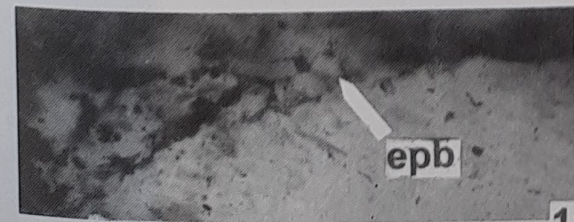
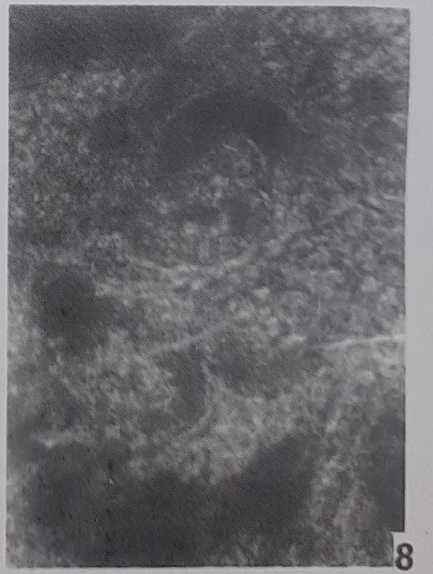
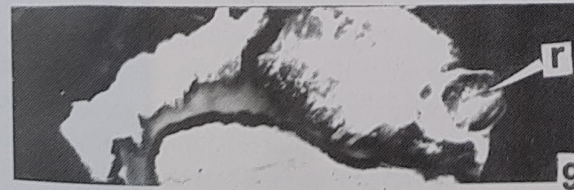
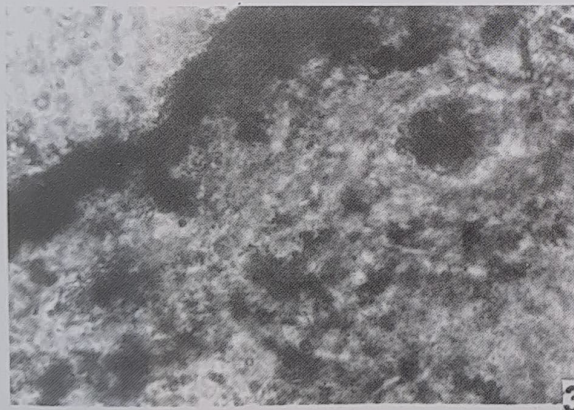
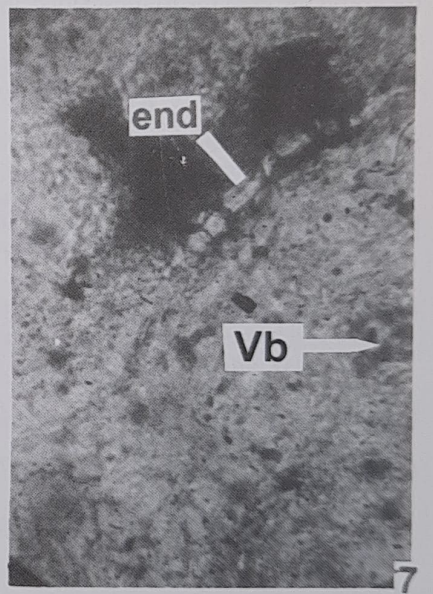
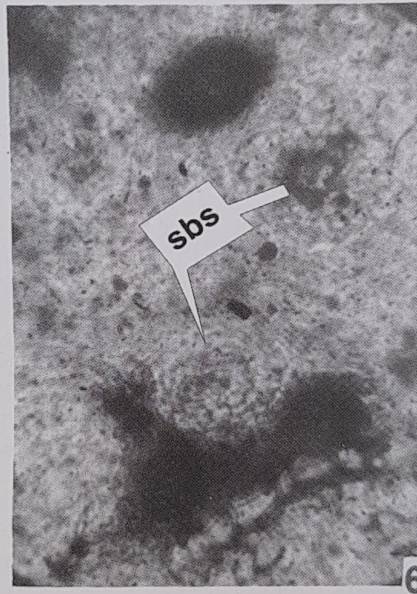
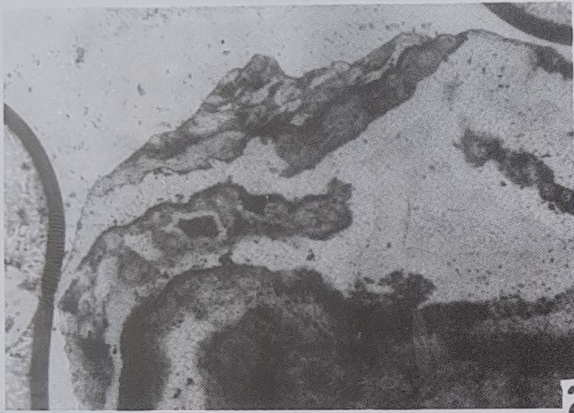
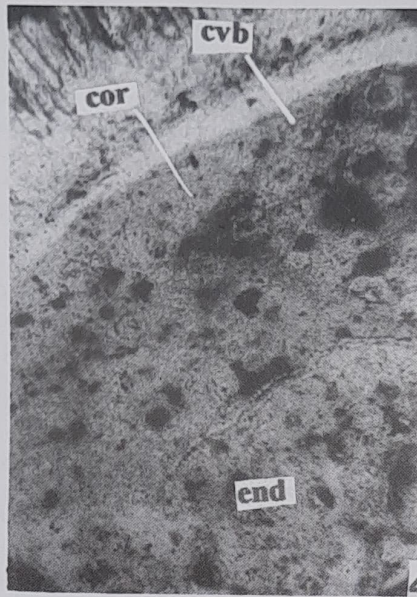
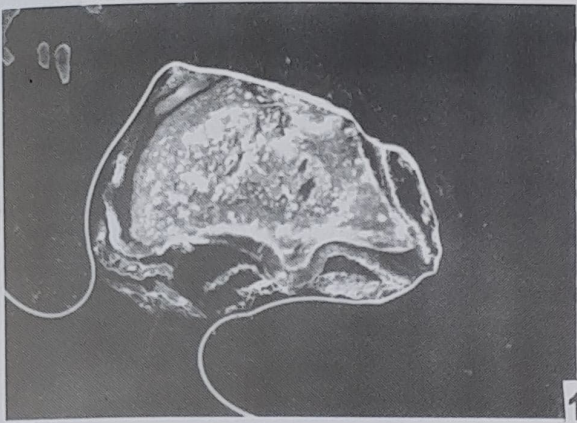


PLATE-1

Endodermis single layered. Vascular bundles in central cylinder collateral, in the leaf sheaths collateral, amphivasal and arranged in a row with alternate arrangement. Roots with thick walled rhizodermis.

Repository - Department of Botany, Smt. K. W. College, Sangli, Maharashtra, India.

Holotype - Museum No. FWN. 31.

Locality - Nawargaon-Maragsur area, Wardha District, Maharashtra, India

Horizon - Deccan Intertrappean Series.

Age - Maastrichtian-Danian.

ACKNOWLEDGEMENTS

The authors express their sincere thanks to Professor A. R. Kulkarni for going through the micro preparations and his valuable comments and to Dr. S. D. Bonde and Dr. J.S. Guleria for going through the manuscript critically and making helpful suggestions.

REFERENCES

- Bande MB, 1987. Fossil wood of *Gmelina* Linn. (Verbenaceae) from the Deccan Intertrappean beds of Nawargaon with comments on the nomenclature of Tertiary woods. *Palaeobotanist* 35(2): 165-170.
- Bonde SD, 2008. Indian fossil Monocotyledons: Current status, recent developments and future directions. *Palaeobotanist* 57(1-2): 141-164.
- Carter HJ, 1852. Geology of the Island of Bombay: *Jour. Bombay branch Royal Asiatic Society* 4: 161. reprinted in "Geological Papers on Western India", edited by Henry J. Carter in 1857. Education Society Press, Bombay: 116-168.
- Chitale SD & Patel MZ, 1970. A petrified monocot leaf from the Deccan Intertrappean cherts of India. *Botanique* 1(1): 43-47.
- Dutta D & Ambwani K, 2005. Occurrence of *Cyperaceocarpon sahnii* gen. et sp. nov. A fossil fruit from the Deccan Intertrappean beds of Mohgaonkalan, Chhindwara District (MP), India. *Phytomorphology* 55: 165-169.
- Govindrajalu E, 1966. The systematic anatomy of South Indian Cyperaceae. *Bulbostylis* Kunth. *J. Linn. Soc.(Bot)*. 59:294-304.
- Govindrajalu E, 1969. The systematic anatomy of South Indian Cyperaceae : *Fuirena* Rottb. *Bot. J. Linn. Soc.* 62: 27-40.
- Govindrajalu E, 1969a. The systematic anatomy of South Indian Cyperaceae : *Cypenus* L. Sub. gen. *Kyllinga* (Rottb) Surinager. *Bot. J. Linn. Soc.* 62:41-58.
- Guleria JS & Srivasatava R, 2001. Fossil dicotyledonous woods from the Deccan Intertrappean beds of Kachchh, Gujarat, Western India. *Palaeontographica* 257: 17-33.
- Holttum RE, 1948. The spikelet in Cyperaceae. *Bot. Rev.* 14: 525-541.
- Keller G, Khosla SC, Sharma R, Khosla A, Bajpai S & Adatte T, 2009. Early Danian planktic foraminifera from Cretaceous-Tertiary Intertrappean beds at Jhilmili, Chhindwara District, Madhya Pradesh, India. *J. Foraminiferal Res.* 39 (1) : 40-55.
- Kern JH, 1962. New look at some Cyperaceae mainly from the tropical stand point. *Advnt. Sci. Lond.* 19: 141-148.
- Koyama T, 1956. Taxonomic study of Cyperaceae. *V. Bot. Mag. Tokyo* 569: 59-67.
- Koyama T, 1960. Some transfer of names related to Cyperaceae. *Bot. Mag. Tokyo* 73: 438.
- Koyama T, 1961. Classification of family Cyperaceae (1). *J. Fac. Sci. Tokyo Univ.* 8: 37:148.
- Koyama T, 1965. Interrelationship between the tribes Legenocarpae and Sciereae (Cyperaceae). *Bull. Torry. Bot. Club.* 92: 250-265.
- Koyama T, 1966. The systematic significance of leaf structure in the tribe Sciereae (Cyperaceae). *Mem. N. Y. Bot. Garden* 16:46-70.
- Koyama T, 1967. The systematic significance of leaf structure in the tribe Sclerieae (Cyperaceae). *Mem. N. Y. bot. Garden* 16: 46-70.
- Kukkonen I, 1967. Vegetative anatomy of *Uncinia* (Cyperaceae). *Ann. Bot.* 31: 523-544.
- Mabberley DJ, 1997. *A Portable Dictionary of Vascular Plants*. Cambridge University Press.
- Metcalfe CR, 1969. Anatomy as an aid to classifying the Cyperaceae. *Amer. J. Bot.* 56(7): 782-790.
- Metcalfe CR, 1971. *Anatomy of the Monocotyledons V-Cyperaceae*. Clarendon Press- Oxford.
- Mora LE, 1960. Beitragezur Entwick lungus geschichte aund vergelei chenden Morphologis der Cyperaceae. *Beitr. Biol. Pfl.*35: 253-341.
- Shete RH, 1989. *Scirpusoxylon indicum* gen. et sp. nov., a Cyperaceous rhizome from Deccan Intertrappean beds of India. In: Biradar NV(Editor). *Proceedings Special Indian Geophytological Conference, Pune, 1986*. University of Poona, Pune. pp. 161-163.