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PREHISTORIC SEED OF DECCAN INTERTRAPPEAN BEDS AT JIWATI, MARAI PATAN, MAHARASHTRA, INDIA

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ABSTRACT

In a quarry close to the village of Marai Patan, Chandrapur, in the Vidarbha area of India, the seed preserved in chert from Deccan Intertrapean levels. The fully silicified fossil seed was exposed by breaking chert with hammers and utilizing the butyl acetate liquid of the peeling process following hydrofluoric acid etching to remove successive peels. Fossil seed is small, oblong, fusiform, or spindle-shaped, with a large center and tapering ends. It has a hypocotyl at one end and is orthotropous and dicotyledonous. the seed at both the chalazal and micropylar ends. The seed coat is unitegmic and poorly separated into the tegmen and testa layers. One layer of undifferentiated cells makes up the testa. Tegmen is a thick-walled, sclerified, single-layered structure. The seed coat encloses an oval seed chamber that holds an embryo. The embryo appears to consist of a single layer of epidermis and cells with thin walls. Within seed cavity, the hypocotyl region separated into radicle and plumule. The seed clearly belongs to *Chitaleospermum* based on comparison with extant fossil evidence and modern genera. Based on its characteristics, this seed is recognized as a new species, *Chitaleospermum deccanii* sp. nov.
Keywords **:** Seed, angiosperm, dicot, Deccan, fossil.

Introduction

A dicotyledonous fossil seed has been described from the recently discovered fossil site Marai Patan in the Vidarbha region of Maharashtra State, central India. The reconstruction based on serial slide examination revealed that the petrified structure under discussion is dicotyledonous seed. A number of seeds have been documented from several fossiliferous locations in India's Deccan Intertrappean beds.

Kumar (1984) reported fossil seed under the name *Clusiocarpus deccani* from the Intertrappean beds of India. *Clusiocarpus indicum* was reported by Kolhe and Wazalwar (1998) from the same beds. *Ramokonospermus chitaleyensus* Matin *et al.* (2009), *Mahabaleyspermum minutum* and *Deccanosperma arillata* are the seeds reported by Juneja (1993) from the Intertrappean beds of India. Shishek and Bhowal (2003) reported fossil seed under the name *Ramaconospermus singpurii* from Singhpur beds of MP, India. *Unanospermum corneri* (Bonde, 1993), *Capparicocarpous nagpurii* (Konde and Kolhe, 2012). *Sahniospemum trapii* (Pundkar, 2017). In addition to these, Some employees have examined the seeds of fruits that have already been reported i.e. *Viracarpon hexaspermum* (Chitaley, 1958) and embryonic structure in Enigmocarpon parijai seeds Sahni (Biradar and Mahabale, 1974). *Phoenicoid* seed (Ambawani and Dutta, 2005). Numerous dicotyledonous and monocotyledonous fruits and seeds have been explained from India's Intertrappean beds. However, reports of seeds that are isolated and extremely uncommon. The seed clearly belongs to *Chitaleospermum patanii* (Ramteke *et al*., 2025). A significant addition to our understanding of fossil seeds is this one, which has been classified as a new species, *Chitaleospermum deccanii* sp. nov. from the recently discovered site Marai Patan.

Material and Method

The seed of Deccan Intertrapean strata was preserved in chert that was revealed in quarry near Marai Patan village in the Vidarbha region of India. This site included isolated mature seeds. Deccan volcanism occurred at the Cretaceous-Tertiary boundary and is thought to have lasted around years (about 67-64 Ma; Chron 30N-29N; Hooper *et al*., 2010).

According to Kapgate *et al*. (2011), the fossil seed was retrieved by shattering portions of chert with hammers and then using the butyl acetate liquid application peel technique to remove consecutive peels from the damaged surface after etching in hydrofluoric acid. The fossil seed is completely silicified within the chert. Peels were kept on glass slides with Canada Balsam-mounted coverslips. The (4X) Sony Camera was employed to capture anatomical photos, and 4.6 exe software Capture Pro was utilized for fossil specimen measurment and photography.

Description

When the gathered black chert breaks, a seed specimen is exposed in longitudinal plane. The ellipsoidal seed has developed into a big embryo and seed coat. The following provides a thorough explanation of each component of the seed, including its shape, coat, testa, tegmen, cavity, embryo, and endosperm.

Seed Morphology

The fossil seed is tiny, oblong, spindle-shaped, or fusiform, broad in middle side and tapering at both ends (Plate 1, Fig. 1). It is orthotropous and dicotyledonous, with a hypocotyl at one end measuring 1600 µm length and 940 µm width. At the micropylar end, the seed width was 30 µm (Plate 1, Fig. 4), while at the chalazal end, it was 200 µm (Plate 1, Fig. 3). The vasculature was not visible. The orthotropous placement is indicated the preserved exostome and chalazal ending in same plane.

Seed coat

The seed coat has a unitegmic structure and not well divided in two layers: testa and tegmen. This fossil specimen exhibits characteristics similar to 25 µm thick seed coat. The seed coat's outer layer is fairly thick. It could be testa. Tegmen comes after this stratum.

Testa

Testa consists of single layer undifferentiated cells. The thickness ranged from 13 µm (Plate 1, Fig. 5).

Tegmen

It is single-layered, sclerified, thick-walled structure measuring 12 µm (Plate 1, Fig. 5). The micropylar end appears to have ruptured (Plate 1, Fig. 4). Sclerenchymatous cells are unevenly organized and lack intercellular gaps. They are rectangular in form and size 10 µm.

Seed Cavity

The seed chamber in the current fossil specimen is oval. An oval seed chamber containing an embryo is enclosed by the seed coat.

Embryo

Embryo appears to be composed of thin-walled cells with a single-layer epidermis. Embryo are big and take up the majority of seed cavity. There are small spaces between the embryo's walls. However, some parenchymatous cells are still present in this nuclear area. The embryo's wall is composed of thin, irregularly shaped parenchymatous cells. The embryo length is less than ¾ of seed length. And the width is comparably little.

Embryo takes up around ¾ of seed width. Embryo septa measure 0.91 mm-1.92 mm thickness. Within seed cavity, the hypocotyl region is separated into radicle and plumule (Plate 1, Fig. 2). The hypocotyl area was around 350 µm in length and 150 µm broad. In the hypocotyl, only a few hexagonal cells measuring 20 µm are visible. Radicle cells range from 30 µm. The embryo's wall is 20 µm thick.

Endosperm

Endosperm tissue may be absorbed as the embryo grows even though it is not visible.

Discussion and Identification

The specimens mentioned above reveal the following key facts for their identification:

1. The seed is minute, oblong, spindle-shaped, or fusiform, with a broad middle and tapering extremities.
2. The seed is dicotyledonous and orthotropous, with a hypocotyl located at one end.
3. The seed coat is unitegmic and poorly separated into the tegmen and testa layers.
4. The tegmen is a single-layered, sclerified structure with thick walls, while one layer of undifferentiated cells makes up the testa.
5. An oval seed chamber that contains an embryo is enclosed by the seed coat.
6. The cells in an embryo have thin walls and single layer of epidermis.

7. The majority of seed cavity is occupied by the big embryo.
8. Within the seed cavity, the hypocotyl area is partitioned into the radicle and plumule.

Based on the aforementioned persona, the present petrified specimen is orthotropous, unitegmic, dicot seed.

Comparison with modern taxa

The current fossil specimen can be compared to the dicotyledonous living families that have unitegmic seeds because it is characterized as having dicotyledonous seeds. About 105 of the 350 families of Dicotyledons seem to have exclusively unitegmic ovules, which are sympetalous and thought to be more developed than polypetalous or apetalous ovules (Corner, 1976). Corner (1976) identified 105 families with unitegmic seeds. Here, we examine families characterized by orthotropous ovules, ellipsoidal seeds, and embryos that fill the seeds, specifically Burseraceae, Monimiaceae, Fagaceae, Rosaceae, Salicaceae, Piperaceae, Rafflesiaceae, Anacardiaceae, Balsaminaceae, Holorrhagaceae, Icadnaceae, and Ochnaceae. Two vestigial integuments are present in the Balsaminaceae, Holorrhagaceae, Icadnaceae, and Ochnaceae families; these integuments are next to chalaza and nucellus and persist at the micropylar end of seed. In this situation is not evident in existing fossil seed cannot be compared to the pachychalazal seeds found in these groups.

In the families Monimiaceae, Fagaceae, Burseraceae, and Salicaceae, The inner integument seems to melt resulting in unitegmic seed. Burseraceae, Fagaceae, and Monimiaceae have unitegmic seeds, however their seed coats are made up of tegmen and testa. The testa clearly multiplicative, with thin-walled, tangentially elongated cells. In all of these families, the seed coat's tegmen layer is eventually or swiftly crushed. Thus, the formation of the seed coat involves only one integument.As a result of its exotegmic origin, the current fossil species bears no resemblance to the aforementioned groups.

There are several parallels between Rosaceae seeds and current fossil seeds but varies from it in that the seed lacks endosperm and either the integument vanishes or both integuments connect to form a pachychalazal seed. When compared to Rafflesiaceae seeds, the current fossil seed differs in that the inner layer of the tegmen has been crushed and it lacks tiny seeds that are 0.5 to 1 mm long. In certain species, testa is single layer pulpy cells, which the current specimen does not exhibit. Anacardiaceae seeds range in size from medium to big, with persistent integuments. In this family, endocarp responsible for the seed coat's protective role. The embryo is bigger and fills the entire seed cavity, which sets it apart from the present seed. This is thought to be more evolved in woodland families (Corner, 1976). When compared to Piperaceae seeds, Most of the traits are shared by the current fossil seed, this family's seeds are ovoid, exarillate, non-multiplicative, and range in length from 1 to 6 mm. Testa was quickly crushing without the trace. At the micropylar end, tegmen is distinct, as is extant fossil seed. As a result, they bear a striking likeness.

Comparison of known fossil seeds

A comparison is made between the current fossil seed and previously documented fossil seeds. In contrast to the existing fossil seed, the previously recorded seed Clusiocarpus arillatus (Kumar, 1984) contains aril. The current fossil seed is different from Ramakonospermus chitaleyensis (Juneja, 1993) in that it does not have bitegmic or mesotestal seeds, and the embryo in the former is bent and convoluted, while the current specimen is straight. Deccanosperma arillata described juneja (1993) varies from the existing fossil seed in that the seed arillate and bitegmic.

The current fossil specimen differs from Clusiocarpus indicum (Wazalwar, 1990) in that the seed coat is differentiated into testa and tegmen, resulting in bitegmic, which is not visible in the described seed.

Unonaspermum corneri described (Bonde, 1993) seeds are elongated, ellipsoidal, and bitegmic. The seed distinguished by a ruminated seed coat. All of the aforementioned characteristics are absent from present fossil seed, indicating that it is unique.

Ambwani and Debi Dutta (2003) collected Arecaceae from a dinosaurian coprolite in Pisdura, Maharashtra. The endosperm cells seem to be ruminated, and the seed has an oval form. Since the modern fossil seed is dicotyledonous, it cannot be compared to this monocot seed.

This document contains unitegmic seed that was gathered from the Deccan Intertrappean Bed at Mohgaonkaln. Ramakonospermus chitaleyensis Matin *et al*. (2009) distinguishes itself by having an anatropous seed, an ex-albuminous seed coat, and a multiplying testa. When compared to Capparicocarpous nagpurii (Konde and Kolhe, 2012), it has a campylotropous ovule, bent embryo, and bitegmic seed coat. Its structure differs from that of all other previously documented seeds, and it does not completely resemble the seeds of any extant family. The seed clearly belongs to *Chitaleospermum patanii*

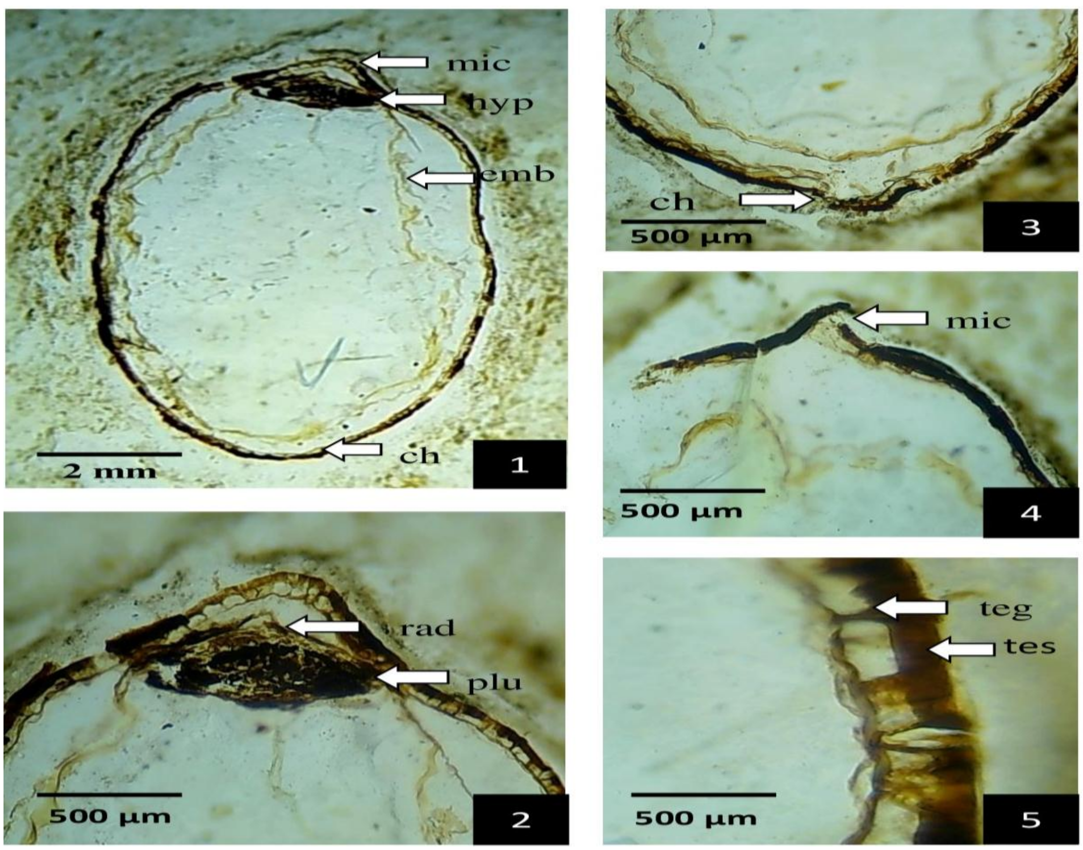
(Ramteke *et al*., 2025). But the size of the current fossil seed is significantly different from that of *Chitaleospermum patanii*, which has well-developed embryonic cells, endosperm, and nuclear remnants. These distinctions support the creation of a new species and are of great taxonomic significance. Hence, it's named *Chitaleospermum deccanii* sp. nov.

Diagnosis

Chitaleospermum deccanii **sp. nov.**

The fossil seed is tiny, oblong, spindle-shaped, or fusiform, broad in middle side and tapering at both ends. It is orthotropous and dicotyledonous, In the seed, the hypocotyle is directed toward the micropylar end, whereas the chalazal end is on the opposite side. The seed coat unitegmic in nature and not well divided in two layers: testa and tegmen. One layer of undifferentiated cells makes up the testa. Tegmen is single-layered, sclerified, thick-walled structure. A breach is seen between the tegmen and the embryo, revealing nuclear endosperm. An oval seed chamber containing an embryo is enclosed by the seed coat. Embryo appears to be composed of thin-walled cells with a single-layer epidermis. Embryo are big and take up the majority of seed cavity. There are small spaces between the embryo's walls. However, some parenchymatous cells are still present in this nuclear area. The embryo's wall composed of thin, irregularly shaped parenchymatous cells. Within the seed cavity, the hypocotyl region is separated into radicle and plumule. A narrow empty gap surrounds the embryo, representing the nucellus. Some nucellar tissue remains parenchymatous. Endosperm tissue remnants were detected at both the chalazal and micropylar ends

Plate I Photo 1 - 5



Chitaleospermum deccanii **sp. nov.**
Explanation of Figures in Plate I (Photo 1 – 5)

Fig 1: L. S. of seed showing anatomical details indicates micropylar end (mic), testa (tes), tegmen (teg), cotyledon (cot), embryo (emb), hypocotyls (hyp), plumule (plu), radical (rad) and chalazal end (ch) ………………..X20.
Fig 2: L. S. seed showing hypocotyls of radical and plumule……………X200
Fig 3: L. S. of seed showing chalazal end (mic)…………… X200.
Fig. 4: L. S. of seed showing micropylar end………………X200
Fig 5: L. S. of seed showing seed coat, testa (tes) and tegmen (teg) ………….X 200.

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Holotype : PBL/ Angiosperm seed/ Deposited in Department of Botany, from Dr. Ambedkar college of Arts, Commerce and science, Chandrapur.

Locality : Marai Patan, Tah. Jiwati, District - Chandrapur, Maharashtra, India.

Horizon : Deccan Intertrappean Beds.

Age : ?Late Cretaceous.

Etymology : The species' name is derived from Deccan Intertrappean beds where the fossil specimen was found

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