



## A PETRIFIED PALM FRUIT *BORASSEOCARPON MOHGAOENSE* FROM THE DECCAN INTERTRAPPEAN BEDS OF MOHGAONKALAN IN MADHYA PRADESH OF CENTRAL INDIA.

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### Abstract:

The fossil fruit is from Mohgaonkalan in Madhya Pradesh of Deccan Intertrappean Beds of central India of probable early Paleocene age. After breaking and itching the chert, the specimen appeared in the form of very massive and elongated structure, two central seed cavities are visible to the unaided eye. It is exposed in longitudinal plane and serial peel sections are taken along longitudinal and transverse plane. The distinctive features of the fruit are epicarp, fibrous mesocarp and stony endocarp with fibrous and fibro vascular bundles. Seeds possess endosperm. Vessels with spiral thickening. It indicates that this fruit represent palm rather than a dicotyledonous family. Fruit 2.5 cm in length and 1 cm in breadth. Embedded in the endosperm small cavities present might be represent cavities of embryo. Thus it is evident that the fossil fruit does not resemble any of the fossil fruit which were reported earlier from the Deccan Intertrappean beds. It shows close approach to the tribe Borasseae of Palmae but not comparable with any genus of Borasseae of Palmae in toto. Hence referred to new form genus *Borasseo crponmohgaoense*. The generic name being after the tribe Borasseae and specific name after the locality Mohgaonkalan.

**Key words:** Palm, Fruit, Paleocene, Intertrappean beds, Deccan, Petrified, Fibrous.

### INTRODUCTION:

The present fossil is a monocotyledonous fruit related to palm. So far only few palm fruits are known from the tertiary formation of India. Monocotyledonous fruits described from the Deccan Intertrappean beds of India are: *Nipa* spp. (Sahni and Rode, 1937); Chitale (1960a, 1960b), *Tricocotestrigonum* (Rode, 1933a; Sahni and Rode, 1937; Chitale, 1957a), *Palmocarpus* spp. (Sahni, 1934; Sahni and Rode, 1937; Mahabale, 1950; Prakash, 1955, 1960b, Patil, 1971; Trivedi and Chandra, 1971a), *Viracarpus* spp. (Sahni, 1934; 1994 Chitale, 1958; Chitale, Shallom and Mehta, 1969, Patil, 1972, 1973); *Sparganium* (Mahabale, 1953); *Musa cardiosperma* (Jain, 1964a); *Cocos* spp. (Patil and Upadhyay, 1979); *Juncaquinocarpus mohgaoensis* (Paradkar and Barlinge, 1980a); *Cocosocarpus mohgaoense* (Khole, 1980); *Hyphaeneocarpus indicum* (Bande, Prakash and Ambwani, 1981), *Monocotylotrobus bractestus* (Lakhanpal, Prakash and Bande, 1982), *Areca intertrappea* (Senad, 1983), *Phoenix intertrappea* (Patki, 1986), *Arecoicarpus kulkarnii* (Bande, 1988); *Palmocarpus rodei* (Kapgade et al., 2011), *Arecoicarpus kulkarnii* (Bande, 1990), *A. perismaticum* (Agrawal et al., 2007), *Palmocarpus patnii* (Patil et al., 2016).

**MATERIAL AND METHODS:** The fossil fruits were collected from Mohagaonkalan beds of Deccan Intertrappean beds of India. After breaking and itching the chert, the specimen appeared in the

form of very massive and elongated structure. Two central cavities are visible to unaided eye. It is exposed in longitudinal plane and serial peel sections are taken along longitudinal and transverse plane.

**Description:** The fruit is obovate, pyriform, gradually attenuated towards the base and apex, sub hemispherical with numerous small inequalities on the surface (plate 1. fig. 1). The specimen is elongated measuring 2.5 cm in length and 2.1 cm in breadth with two seed cavities (plate 1. fig. 1). Upper cavity measures 2 to 6 mm in length and 4 mm in breadth. Lower cavity is slightly larger than upper one (plate 1. fig. 1). The maximum size of the cavity is 8 mm in diameter and goes on reducing in size in further sections till it becomes 2 mm in diameter. In last few sections in L.S. the seed cavity is completely replaced by parenchymatous cells. The fruit shows presence of three projection in L.S. and T.S. (Plate 1. fig. 1). Pericarp is well preserved and it is moderately thick measuring 3 to 4 mm in thickness. It is differentiated into Epicarp, fibrous mesocarp and stony endocarp (Plate 1. fig. 1).

**Epicarp:** it is wavy due to presence of ridges and furrows and it measures 250 $\mu$  to 275 $\mu$  (Plate 1, fig. 1 and 2). It is lined on its outside by single layered epidermis. (Plate 1, fig. 2 and 3). Epidermal cells are tangentially elongated with granular contents. These are compactly arranged and parenchymatous with thick cuticle (Plate 1, fig. 2 and 3). Epidermis is followed by 6 to 8

layered hypodermis where is vcells are packed with some unknown contents. Therefore, this zone looks dark brown in colour.

**Mesocarp:** It is lacunar. In mesocarp, some cells are broken down to form irregular cavities. These are lysiginous cavities (Plate1, fig. 3 and 5). Smaller and larger lysiginous cavities measures 2 to 50 $\mu$ , and 255 to 5500 $\mu$  respectively. Small canals are present in mesocarp (Plate 1. fig. 3). These are linedbu 1-3 layered epithelial cells. These canals measure 157 $\mu$  in diameter. These might represent oil glands. Mesocarp is not uniform in thickness (plate 1. fig. 1). The maximum thickness of mesocarp in 2500 $\mu$  and minimum thickness is 500 $\mu$ . It is made up of ground tissue of thick walled parenchymatous cells (plate 1, fig 2 ad 6), which are irregular in shape, some being oblong, while rest are round in shape. Ground tissue of the mesocarp encloses small intercellular spaces in between the cells. At some places, cells of ground tissue are not well preserved. There are two types of scattered bundles of mesocarp: fibrovascular bundles and fibrous bundles.

**Fibrovascular bundles:** These are conjoint collateral (plate 1, fig 5) and closed and measures 83 $\mu$  to 155 $\mu$  in diameter. Each bundles consist of xylem and phloem with phloem facing towards the upper side. Details of phloem could not be studied as it is broken due to pressure. There is outer concave sclerenchymatous sheath above the phloem. No sclerenchymatous sheath is preserved on two lateral sides. The xylem elements of these bundles are arranged with metaxylem towards periphery and protoxylem is not well preserved. The vessel show spiral thickening (plate 1, fig. 3) and vessel diameter is 17 $\mu$  to 19 $\mu$ . Fibrovascular bundles are few in number.

**Fibrous Bundle:** These bundles are irregularly distributed in ground tissue. (Plate 1, fig. 3 and 4). Each bundle is more or less round to oval and some have irregularly shape and measured 60 $\mu$  to 163 $\mu$  in size. Each bundle is made up of fibers only (Plate 1 fig. 4). The fibers are septatae with simple pitting on their radial walls. Each fiber measures 50 $\mu$  to 96 $\mu$  long and 13 $\mu$  to 30 $\mu$  broad.

**Endocarp:** Endocarp is stony. It forms the innermost layer of pericarp. Some part endocarp is common to both seeds (Plate 1, fig. 1) and its measures 1125 $\mu$  to 1500 $\mu$ . In addition to common endocarp, both seeds have separate endocarp(Plate 1. Fig. 1). Endocarp of upper seed measures 625 to 875 $\mu$  in thickness and that of lower seed measures 625 to 1125 $\mu$ .

The cells of the endocarp are moderately thick walled consisting of parenchymatous cells which

measures 12 to 19 $\mu$ . These cells are packed with some contents and therefore look dark brown in colour (Plate 2, fig. 1). Fibrous bundles are present in this region (Plate 2, fig4.). In between two seed cavities, there is a dark patch of endocarp in which fibrovascular, (Plate2, fig. 3). Fibrous bundle and sclerieds are present. In oblique section, fibrovascular bundles in this region consist of vessels showing spiral thickening and measure 142 $\mu$  while vessel measures 25 $\mu$ .

Both the seeds posses layers of endosperm which is ill preserved (Plate 2, fig.1 and 2). It is narrow zone consisting of very thin walled parenchymatous cells and it is 8 to 10 layered without any contents (Plate 2, fig. 1 and 2). In L.S. endosperm cavity of upper seed measures 4 mm and that of lower seed measures 5 mm. Endosperm cavity shows some on growths of endosperm tissue due to which cavity looks wavy (Plate 2, fig. 2). Cells of endosperm are thin walled and they measure 13 $\mu$  in size and some larger cells measure 33 $\mu$ . They are compactly arranged. Endosperm of upper seed measures 375 to 550 $\mu$  and that of lower seed measures 625 to 750 $\mu$ . Embedded in the endosperm tissue, there is a small cavity (Plate 2, fig. 1) which might represent the cavity of embryo. Embryonic cavity measures 875 $\mu$  (apical in position). This 8 to 10 layered zone linig the cavity constitute the outer part of endosperm (beginning of edible part of palm fruit) and central cavity might represent the bulk of original endosperm space containing watery contents (milky).

**Identification:** The fossil fruit is identified with the help of following characters:

1. Fruit is bilocular with thick pericarp.
2. Pericarp is differentiated into epicarp, mesocarp and endocarp.
3. Epicarp is moderately thick, distinct epidermis with ridges and furrows are present.
4. Hypodermis is 6-8 layered.
5. In mesocarp smaller and larger cavities are present. Mesocarp is fibrous and contains fibrous and fibrovascular bundles.
6. Endocarp shows presence of content and is stony.
7. Endosperm is represented by 8-10 layer of cells. Endosperm cavities are present with single seed in each. The endosperm of upper seed shows presence of embryonic cavity.

The above mentioned characters clearly indicate that it is a monocotyledonous drupe. Drupes are generally seen in families Typhaceae, Sparganiaceae, Pandanaceae, Palmae. But in family Typhaceae the fruits are mostly achene. In

Padanaceae the fruits are found in cluster. In Sparaniaceae fruits are generally unilocular but bilocular and trilocular condition is also seen in some species. After eliminating above mentioned monocotyledonous families, the present fruit is preferable to the family Palmae because:

1. Fruit is drupe.
2. Pericarp is differentiated into epicarp, fibrous mesocarp and endocarp.
3. Endocarp is present.

In Palmae gynoecium is generally tri carpellary but sometimes more carpels are present. In some members of Palmae, some of the carpels become abortive, thus resulting in the formation of mono or bicarpellary drupe. In the present fossil fruit, it is seen that only two locules are present, so it might have developed from bicarpellary gynoecium where third carpel must have been aborted. The fossil palm fruits where the affinities are not certain are placed under the form genus *Palmocarpon*. The affinities are traced with known species of *Palmocarpon*.

Rendle (1967) divided Palmae into 7 tribes.

1. Phoeniceae – Fruit berry.
2. Sabaleae – Fruit berry or a drupe with thin endocarp. Endosperm is often ruminant.
3. Borasseae – Large drupe, containing 1 to 3 seeds, each enclosed in separate chamber formed by a stony endocarp.
4. Lepdocaryeae – one seeded fruit coated with a layer of hard, shining, imbricate scales.
5. Araceae – The fruits is a juicy or fibrous fleshy berry. The endosperm is ruminant.
6. Coccoceae – one seeded drupe.
7. Phytelphanteae – fruit drupe, solitary seed is enclosed in the woody endocarp which passes gradually into the fibrous mesocarp.

Out of these 7 tribes, the fossil materials resembles the tribe Borasseae because-

1. Fruits here is obovate, pyriform gradually tapering towards the base with numerous and small inequalities on surface.
2. Fruits in drupe containing 2 seeds, each enclosed in separate chamber formed by stony endocarp.
3. Pericarp is very large as compared to the seeds.
4. Endocarp is moderately thick.

In Borasseae fruit develops from trilocular ovary. But in present specimen. The number of locules countable are only two. Fossil fruit resembles *Latina loddigesii* mart. Of Borasseae, in having 2-seeds, each enclosed in a thick endocarp. But in *Latania*, mesocarp is succulent (Blatter, 1978) where fruit it is fibrous.

Thus, it is evident from the discussion that present fossil fruit does not resemble any of the

fossil fruits which were reported from Deccan Intertrappean beds. It shows close approach to the tribe Borasseae of Palmae in toto and hence referred to a new form genus *Borasseocarpon mohagaoense*. The generic name being after the tribe Borasseae and specific name after the locality Mohgaonkalam.

**Diagnosis:** *Borasseo carpon* gen. nov.

The fruit obovate, pyriform, gradually attenuate towards the base, sub hemispherical with numerous small inequalities on the surface. Fruit, two seeded drupe with pericarp differentiated into epicarp, mesocarp and endocarp. Fruit with three projections 2.5 cm in length and 1 cm in breadth, upper cavity 2 to 6 mm in length and 4mm in breadth, lower cavity 2 to 8 mm in diameter. Epicarp with ridges and furrows, hypodermis present below the epidermis, mesocarp with fibrous and fibrovascular bundles, small and large cavities and canal present in mesocarp, endocarp not very strong, contains fibrovascular, fibrous bundle and sclerids, endosperm present, embryonal cavity present

*Borasseocarpon mohagaoense* gen. et sp. nov.

Fruit 2.5 cm in length and 1 cm in breadth with three projections in L.S and T.S. Fruit with two cavities. Upper cavity 2 to 6 mm in length and 4mm in breadth. Lower cavity 2 to 8 mm in diameter. Epicarp 250 to 275 $\mu$  thick, presence of ridges and furrows on epidermis 6 to 8 layered. Mesocarp not uniform in thickness, maximum thickness 2500 $\mu$  and minimum 500 $\mu$  (smaller) with cavities which measure 2.50 $\mu$  and 225 to 5500 $\mu$ . Lysiginous canals, fibrovascular, fibrous bundle in mesocarp. Canals 157 $\mu$  in diameter, fibrovascular bundles conjoint, collateral and closed with sclerenchymatous sheath 83 $\mu$  to 155 $\mu$  in diameter; metaxylem present towards the periphery of the fibrovascular bundle, protoxylem not preserved and vessel 17 $\mu$  to 19 $\mu$  in diameter with spiral thickening, endocarp, some part, it is common on both seeds, 1125 $\mu$  to 1500 $\mu$  thick. Endocarp of upper seed 625 to 875 $\mu$  in thickness, and lower seed 625 to 1125 $\mu$  in thickness, stony contains fibro vascular, fibrous bundles and sclereids, fibro vascular bundle 142 $\mu$ , vessel with spiral thickening with vessel member 25 $\mu$  in 25 $\mu$ . Endosperm present in both seeds, it is 8 to 10 layers of cell without any contents. In L.S. upper endosperm cavity 4 mm and lower seed 5mm. Endosperm of upper seed 375 to 550 $\mu$  and that of lower seed 625 to 730 $\mu$ . It might represent cavity of embryo (apical?).

Holotype : Deposited at Institute of science, Nagpur.

Locality: Mohgaonkalan, Madhya Pradesh, India.

Horison: Deccan Intertrappean beds of India.  
Age: Late cretaceous.

**Explanation of Plate 1:**

*Borasseocarpon mohagaense* gen. et sp. nov.

- Fig. 1: Longitudinal section of palm fruit showing projections, epicarp, mesocarp, endocarp and two seed cavities. x5
- Fig. 2: Longitudinal section of fruit showing epicarp with ridges and furrows and mesocarp. Epicarp with epidermis and hypodermis. x155
- Fig. 3: Cannals in mesocarp lined by epithelial parenchymatous cells. X200
- Fig. 4: Different shapes of fibrous bundle in mesocarp. x165
- Fig. 5: Fibrovascular bundles in mesocarp. x200
- Fig. 6: Air cavities in mesocarp. x155

**Explanation of Plate 2:**

*Borasseocarpon mohagaense* gen. et sp. nov.

- Fig. 1: Stony endocarp with endosperm and embryonal cavity in endosperm (arrow). x90
- Fig. 2: Endocarp with soft parenchymatous endosperm. x155
- Fig. 3: Vessels in endocarp showing spiral pitting. x580
- Fig. 4: Fibrous bundles in endocarp. x 200

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