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Investigation of A New Petrified Trilocular Fruit from the Deccan Intertrappean Beds of Bhutera, M.P. India.

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Abstract
This investigation of fossil trilocular fruit from the newly explored locality Bhutera from the Deccan Intertrappen beds of central India. The transversely exposed fruit measures 2.5 X 3 mm in size. The petrified, well preserved fruit is small, obovate and triangular in shape. It is broad in the middle and narrower towards the apex than the base. The apex is marked with an opening called dehiscence. The fruit shows three locules. Out of these three locules two contains single, large, wrinkled seed in each while third locule is sterile, quite larger than the fertile locules and is without any seed sterile locule and abortive in nature.

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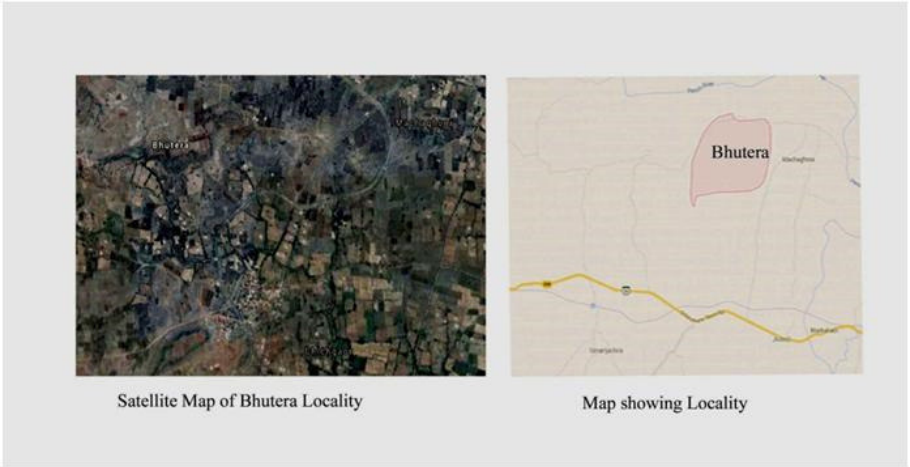
INTRODUCTION

The Deccan Intertrappean beds, deposited in central India near the boundary of the Cretaceous and Paleocene, preserve abundant and well preserved plant remains that offer important insights into the diversity, evolution, and biogeography of the Indian flora at a time when India was an isolated landmass (reviewed by Prakash 1960; Kapgate 2005). The present paper deals with the study of new petrified dicot, trilocular fruit. Obliquely transverse exposed fruit is collected from the new locality Bhutera (Lat. 22°06.58'N, Long. 79°08.42'E) of Chhindwara district, Madhya Pradesh. It is 30 km from Chhindwara on Seoni road and 10 km from north of Jhilmily railway station which is of Uppermost Cretaceous to Lower Paleocene age. So far from this locality multiseeded capsular fruit *portulacaceocarpon oleraceae* (Borkar & Nagrale 2016) is reported.

From the Deccan Intertrappean beds many dicot trilocular fruits have been reported, such as *Tricoccites* sp. (Sahni & Rode 1937, Chitley 1956), *Euphorbiocarpon deccanii* (Upadhye, 1979), *Euphorbiocarpon drypeteoides* (Mehrotra *et al.*, 1983), *Triloculocarpon mahabalei* (Kapgate 1988), *Phyllanthocarpon singpurii* (Mistri *et al.*, 1992), *Trialata malphighicea* (Dixit 1998), *Euphorbioceocarpon singpurii* (Bhowal & Sheikh 2006), *Pantocarpon deccanii* (Kapgate *et al.*, 2007). One more fossil dicotyledonous trilocular capsular fruit is now being described in this paper from Deccan Intertrappean beds of Bhutera, M.P., India.



Satellite Map of Bhutera Locality Map showing Locality

MATERIAL AND METHOD

The fossiliferous cherts had been collected from the Deccan Intertrappean beds of Bhutera, M.P., India. While breaking the cherts the fruits were exposed in transverse plane. After etching the specimens with hydrofluoric acid (HF), serial peel sections are taken with cellulose acetate peel technique (Darrah, 1936; Galtier & Phillips, 1999). The peels were mounted in DPX mountant and photographed. The camera lucida sketches of

the slides are drawn for detailed study of fruit cut in transverse plane.

DESCRIPTION

The transversely exposed fruit measures 2.5 X 3 mm in size. The fruit shows three locules. Out of these three locules two contains single, large, wrinkled seed in each while third locule is sterile, quite larger than the fertile locules and is without any seed (Pl.1 fig.1, Pl.2 fig.2). The pericarp measures 150 to 160 µm in size and multilayered. The seed measure 300 to 450 X 620 to 780 µm in size. The seed coat is bitegmic in nature. The embryo is dicot and ill preserved, placentation is axile Vasculature not clearly seen. Dehiscence is loculicidal. The detailed description of each part is given below in the following sequence – fruit morphology, pericarp, locule, placenta, seed, seed coat and embryo.

Fruit morphology

The petrified, well preserved fruit is small, obovate, triangular in shape. It is broad in the middle and narrower towards the apex than the base. The apex is marked with an opening called dehiscence (Pl.1 fig.1, 3), whereas the base is globous. The fruit measures 3 mm in length and 2.5 mm across at the broadest middle part.

Pericarp (Fruit Wall)

The fruit wall or pericarp is well preserved and moderately thick, multilayered without any outgrowth and measures about 150 to 160 µm and is differentiated into outer epicarp, middle mesocarp, and inner endocarp (Pl.1 fig.2).

Epicarp

It is the outermost layer of the fruit measures 45 to 50 µm in thickness, made up of 4-5 layered, thin walled compactly arranged paranchymatous cells. Each cell measures 10 to 12 µm in size.

Mesocarp

Middle zone mesocarp is thick and measures 85 to 90 µm made up of 7-8 layers of thick walled parenchymatous cells, each cell measures 12 to 14 µm in size.

Endocarp

It is the innermost single celled layer, made up of rectangular, elongated parenchymatous cell measures 20 to 22 µm in size.

Inner pulp

In between pericarp and seeds a few thin walled parenchymatous cells are preserved at places; otherwise except for the seed and placenta no other tissue is preserved. These cells inside fruit measure about 3 × 4 µm in size.

Locules

The locules are three in number of which two are smaller and functional containing one seed in each (Pl.1 fig.4, 5), while the third locule is sterile, quite larger than fertile locule and is without any seed (Pl.1 fig.1, 3).

Seed

The two functional locules contain one seed in each. The seeds are free from fruit wall. Each seed is larger, wrinkled and elongated occupying the complete lumen of locule and measures 300 to 450 X 620 to 780 µm in size.

Seed coat is bitegmic 2-3 layered, measuring 20 to 30 µm in thickness. Outer testa consisting of 1-2 thick walled parenchymatous cells while inner tegmen is prominent, single layered, made up of thin wall parenchymatous cells. At places inner tegmen fused with seed showing undifferentiated nature (Corner, 1976; Fahn, 1989). The mature seed shows ill preserved dicot embryo. The endosperm tissue is ill preserved showing angular to oval parenchymatous patches at places (Pl.2 fig.5).

Placentation

Each seed shows its attachment towards central axis by means of their placental stalk indicating its axile placentation (Pl.1 fig.3).

Dehiscence

The pericarp breaks at the apex above the sterile locule of the fruit showing mature nature with loculicidal dehiscence (Pl.1 fig.1, 3).

Axis

Central axis composed of parenchymatous ground tissue with vascular supply as a dark patches (Pl.2 fig.4).

Embryo

Embryo appears to be made up of thin walled cells with single layer epidermis. It is relatively large and curved. Embryo measures about 75 × 56 µm in size. The embryo is dicotyledonous having two cotyledons and hypostase (Pl.2 fig.1).. At the chalazal end of the seed is seen a dark structure of hypostase. The undifferentiated cellular mass of thin walled parenchymatous cells is found (Pl.1 fig.2, Pl.2 fig.3).

DISCUSSION AND IDENTIFICATION

The above described specimen revealed following important details for its identification.

1. Fruit is trilocular, dehiscent and obovate.
2. Three locules out of which two are fertile and smaller, while third one is larger and without seed formation.
3. Fruit wall is dry, multilayered differentiated into outer epicarp, middle thick mesocarp and inner thin endocarp.
4. Dehiscence is loculicidal.

5. Seeds are showing axile placentation.
6. Embryo large, curved, hypocotylar and dicotyledonous.

From the above features the present fruit is confirmed as trilocular, capsular, dicot fruit showing loculicidal dehiscence with axile placentation. Two locules are functional containing one seed in each and third locule is without any seed formation may be giving buoyancy to fruit for dispersal. Nature of the fruit appears capsular due to fleshy pericarp and dehiscence.

The present fruit is compared with already reported capsular fruits and with modern taxa.

Comparison with fossil fruits

The previously described fossil trilocular fruits from Deccan Intertrappean Beds of India differ from the present fruit in number of characters, the differing characters are as fallows -*Tricoccites sp.* (Chitley & Rode 1937; Chitley 1956) is monocotyledonous triangular fruit having one seed in each locule, pericarp fleshy and seed coat is multilayered. *Euphorbiocarpon drypeteoides* (Mehrotra *et al.*, 1983) is dicotyledonous drupe of size 2.5 mm long & 1.2 mm broad i.e. much smaller than the present fruit having one seed in each locule. *Triloculocarpon mahabalei* (Kapgate. 1988) is a monocotyledonous triangular fruit having two seeds in each locule with loculicidal dehiscence. *Phyllanthocarpon singpuri* (Mistri *et al.*, 1992) is a dicotyledonous capsule having two seeds in each locule with septicidal dehiscence. *Trialata malphighicea* (Dixit, 1998) is a dicotyledonous samara with one winged seed in each locule. *Euphorbioceocarpon singhpurii* (Bhowal & Sheikh 2006) is a dicotyledonous capsule with one seed in each locule with septicidal dehiscence and have glandular hairs on epicarp of fruit wall. *Pantocarpon deccanii* (Kapgate *et al.*, 2007) is a dicotyledonous capsule with one seed in each locule.

All above fruits are with three functional locules with 1-2 seeds in each locule but present specimen differ from all these fruits in having third abortive locule without seed formation. Hence the present fruit does not show exact similarity with any of the reported fossil fruit.

Comparison with the modern taxa

It is compared with trilocular fruits of modern families like- Caryophyllaceae, Myrtaceae, Malphighiaceae, Portulacaceae, Sapindaceae, Malvaceae, Sterculiaceae, Tiliaceae, Zygophyllaceae, Geraniaceae, Rutaceae, Lythraceae, Podostemonaceae and Euphorbiaceae which resembles in trilocular, 2 – 5 chambered loculicidal capsular fruits [Cook (1958); Benthom and Hooker (1961); Rendle (1971)]. Sapindaceae is similar in having trilocular capsule but differs in septisidal nature while present fruit shows loculisidal nature of dehiscence. Lythraceae is similar in 3-4 celled ovary with loculisidal capsule but differs in third abortive locule in present specimen. Podostemonaceae is also differs in having septicidal capsule. Loculicidal or Septicidal dehiscence of the fruit is also observed in family Myrtaceae, but it is usually crowned with persistant calyx; its seeds are angular in shape; showing marked difference from the described fruit. The present fruit is also different from family Malphighiaceae in having winged seeds. In family Geraniaceae also contains trilocular fruits but differ in having one to two ovules in each locule. Family Malvaceae also contains loculicidal capsules but differ from the following fruit in having reniform or obovoid seeds and curved embryo. Family Portulaceae and Caryophyllaceae differs in having valvular dehiscence. Family Zygophyllaceae differs in having septicidal dehiscence of fruit. Family Rutaceae differs in having one to two ovules in each locule. Family Sterculiaceae differs in having flat cotyledons while family. Tiliaceae have leafy cotyledons.

Euphorbiaceae is similar in having trilocular capsule but differs in having third abortive locule. Sometimes in Euphobiaceae due to abortion the locule remains sterile without seed formation but it is not the characteristic of any genus in Euphorbiaceae but happens rarely due to abortion. So, the present fruit is fossil genera & hence for time being new name *Triloculocarpon bhuteriense* sp. nov not comparable with any genus of the modern families and also with reported. is given to the present fruit. The present fruit is kept in the form genus *Triloculocarpon* (Kapgate, 1988) due to its trilocular nature and specific name after the locality of Deccan Intertrappean beds.

DIAGNOSIS

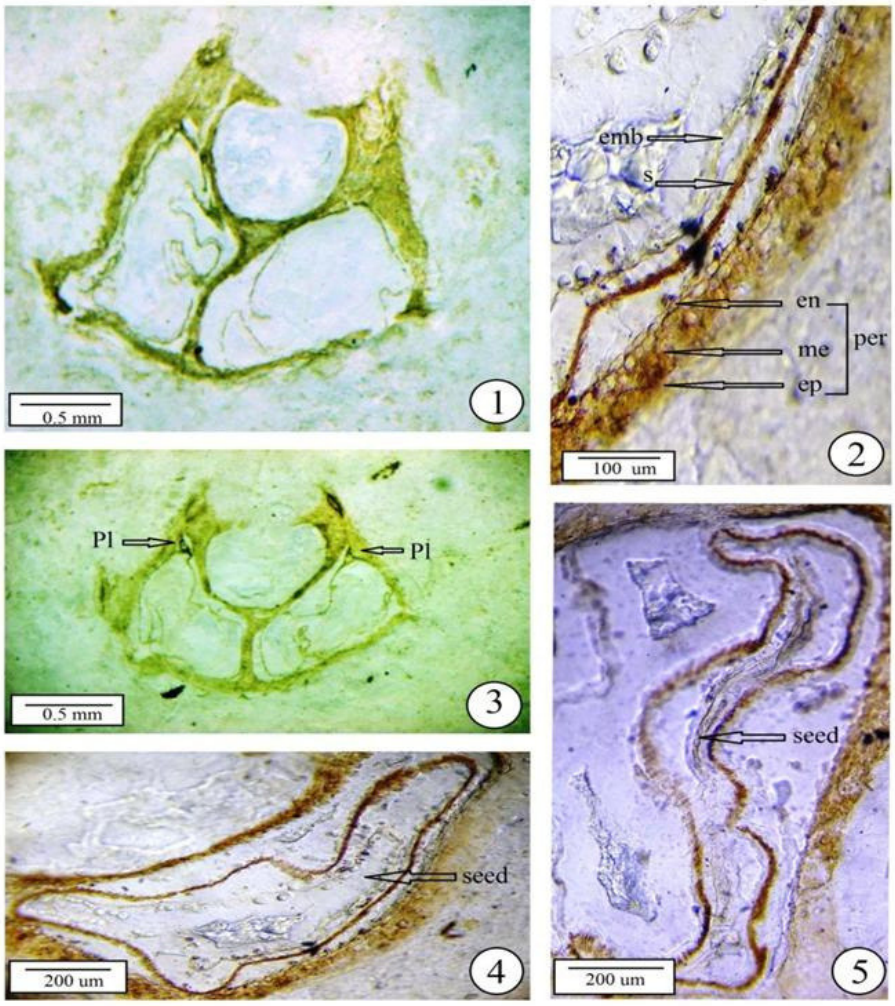
***Triloculocarpon bhuteriense* sp. nov.**

The fruit is trilocular, obovate capsule showing loculisidal dehiscence with two chambers having one seed in each and the third chamber is quite larger and without any seed varying from 1.08 to 1.55 X 2.00 to 2.70 mm in size. Pericarp 150 to 160 um thick, multilayered; outer and middle thick zones and inner thin zone. Seed large wrinkled measures 380-540 X 608-800 um occupies complete lumen of locule showing axile

placentation. Seed coat bitegmic, outer testa 1-2 layered thick walled parenchymatous while inner tegmen is single layered thin walled parenchymatous. Embryo dicot and ill preserved. Endosperm tissue in the form of angular to oval parenchymatous patches at places. Vasculature seen as a dark spots.

Holotype:-ANR/Fruit/Dept. of Botany, janta Mahavidyalaya, chandrapur.
Horizone:-Deccan Intertrappean Series of India.
Locality:-Bhutera (M. P.)
Age:-Uppermost Cretaceous

Plate 1

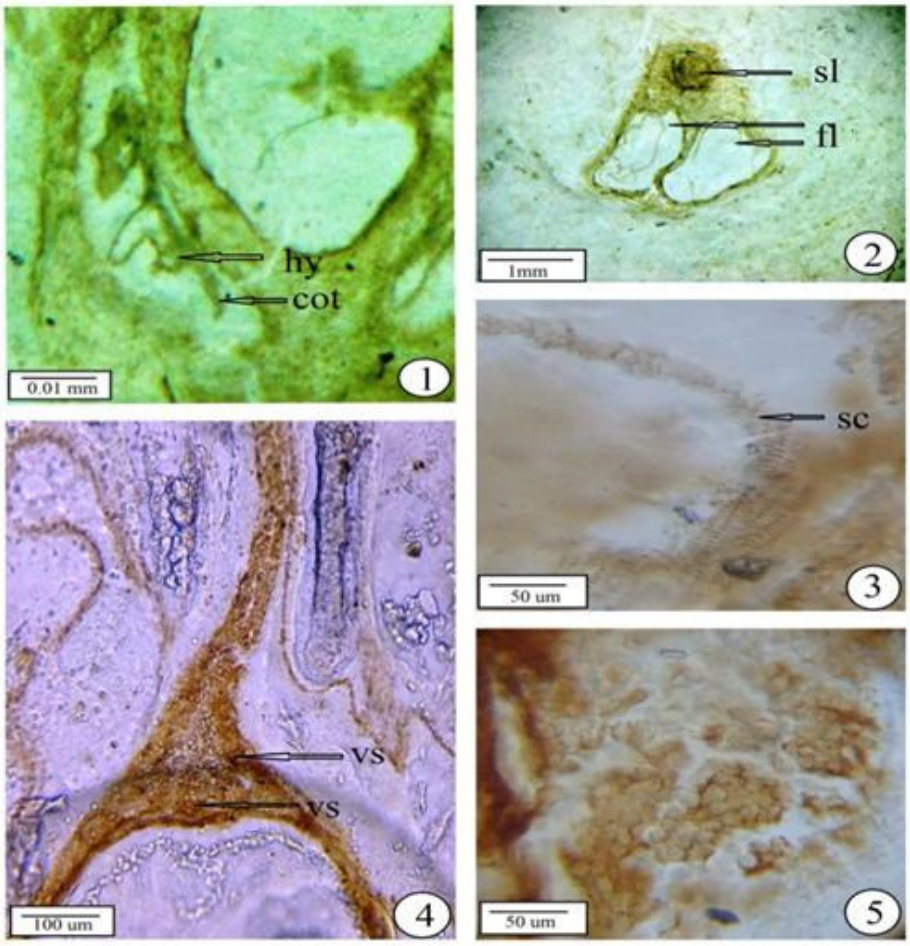


Triloculocarpon bhuteriense sp. nov.

Explanation of Plate 1 figures 1 to 5

1. Fruit exposed on fossiliferous chert in T.S. 100X
2. Magnified view of pericarp (per) showing outer epicarp (ep), middle mesocarp (me) an inner endocarp (en), seed (s) and embryo (emb). 400X
3. T.S. of fruit showing placentation (Pl). 100X
4. One locule enlarged showing seed with embryo. 400X
5. Another locule enlarged showing seed. 400X

Plate 2



Triloculocarpon bhuteriense sp. nov.

Explanation of Plate 2 figures 1 to 5

1. Magnified view of one locule showing embryo with cotyledon (cot) and hypocotyls (hy). 400X
2. T.S. of fruit showing two fertile locule (fl) and one sterile locule (sl). 100X
3. Seed coat (sc) in enlarged view. 400X
4. Central axis showing parenchymatous pith and vascular elements (vs). 400X
5. Magnified view of parenchymatous cells of endosperm. 400X

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