

# *Spinocarpon mohgaoense* gen. et sp. nov., a permineralized spiny fruit from the Deccan Intertrappean beds of Mohgaonkalan, Madhya Pradesh, India

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Manuscript received: 28 December 2011  
Accepted for publication: 07 January 2013

## ABSTRACT

Kapgate D. K. 2013. *Spinocarpon mohgaoense* gen. et sp. nov., a permineralized spiny fruit from the Deccan Intertrappean beds of Mohgaonkalan, Madhya Pradesh, India. Geophytology 43(1): 51-56.

*Spinocarpon mohgaoense* gen. et sp. nov., a fossil spiny fruit, showing close affinity with the genus *Xanthium* of the family Asteraceae, is reported for the first time from Deccan Intertrappean exposures of Mohgaonkalan, Madhya Pradesh.

**Key-words:** Dicotyledonous fruit, Asteraceae, Deccan Intertrappean, Late Cretaceous, Mohgaonkalan, Madhya Pradesh, India.

## INTRODUCTION

The paper reports occurrence of an urticle type of dicot fruit belonging to family Asteraceae from Mohgaonkalan locality, Chhindwara District, Madhya Pradesh. Many dicot fruits have been reported from the Deccan Intertrappean beds. Among the reported dicot fruits, there are some records of dry capsular fruits, viz. *Enigmocarpon parijaii* Sahni 1943, *Indocarpa intertrappea* Jain 1964, *Harrisocarpon sahnii* Chitaley & Nambudiri 1973, *Sahnioecarpon harrisii* Chitaley & Patil 1973, *Daberocarpon gerhardii* Chitaley & Sheikh 1973, *Deccanocarpon arnoldii* Paradkar 1975, *Centrospermocarpon chitaleyi* Sheikh & Khubalkar 1982, *Euphorbiocarpon drypeteoides* Mehrotra et al. 1983, *Wingospermocarpon mohgaoense* Sheikh & Kapgate 1984, *Phyllanthocarpon singhpurii* Mistri et al. 1992,

*Pentaloculocarpon chitaleyi* Kapgate & Kapgate 1999, *Lytherocarpon mohgaonse* Kapgate et al. 2003, *Boehmeria intertrappea* Ambwani et al. 2004, *Surangeocarpon mohgaoense* Kapgate et al. 2005, *Chitaleocarpon intertrappea* Kapgate et al. 2006, *Pantocarpon deccanii* Kapgate et al. 2007, *Limnophyllocarpon surangei* Kolhe et al. 2009. But the fruit described here is spiny and quite different from aforesaid fruits and hence formed the matter for present investigation.

## MATERIAL AND METHOD

The fossiliferous cherts were collected from the Deccan Intertrappean beds of Mohgaonkalan, Madhya Pradesh, India. While breaking the cherts, two specimens of the present fruit were exposed in oblique longitudinal plane. After etching the specimens with hydrofluoric acid (HF), serial peel sections are taken

with Cellulose Acetate peel Technique. The peels were mounted in DPX mountant and photographed.

## SYSTEMATIC DESCRIPTION

**Family: Asteraceae**

**Genus: *Spinocarpon* Kapgate, gen. nov.**

***Spinocarpon mohgaoense* Kapgate, sp. nov.**

Plate 1, figures 1-8, Plate 2, figures 1-7

The fruit is oval to oblong in shape and measures 0.825 to 0.95 mm in length and 0.7 to 0.725 mm in width. It shows two locules with two erect mucronate beaks, pubescent, thickly clothed with spines or prickles. Persistent style-base tapering to an acute point seen at terminal part of the locule (Plate 1, figures 1-5). It is well preserved to reveal anatomical details of pericarp and seed. Pericarp (fruit wall) is spiny and 95 to 110  $\mu\text{m}$  thick, multilayered, differentiated into three zones (Plate 1, figures 6-7, Plate 2, figures 4-5). Outer zone (exocarp), measuring 50 to 55  $\mu\text{m}$  thick, consists of epicarp and external outgrowth as spines. The spines are unequal in size, broad at base and pointed towards apex (Plate 1, figures 5-7). Size of these spines varies from 60 to 75  $\mu\text{m}$  in length and 35 to 40  $\mu\text{m}$  at basal part. 4-5 layered thick epicarp is present below the spines. It consists of thin walled compactly arranged parenchymatous cells. Each cell measures 10 to 13  $\mu\text{m}$  in diameter (Plate 2, figures 4-5). Middle zone (mesocarp) measures 40 to 45  $\mu\text{m}$  and is made up of 1-2 layers of compactly arranged, thick walled, rectangular parenchymatous cells, measuring 20 to 25  $\mu\text{m}$  (Plate 2, figure 5). The inner zone (endocarp) is 35 to 40  $\mu\text{m}$  thick and consists of 3-4 layers of thin walled parenchymatous cells (Plate 2, figure 5). Locules are variable in size. The larger locule measures 0.450 x 0.390 mm in size while the smaller locule measures 0.550 x 0.410 mm in size. Each locule consists of a single seed occupying complete lumen of the locule with

basal placentation (Plate 1, figures 1-4). Seeds are free from fruit wall (Plate 2, figure 1). At few places, it seems to fuse with endocarp. The seeds are variable in size as that of locule. The larger locule contains larger seed and measures 0.45 x 0.375 mm in size while the smaller locule contains smaller seed measuring 0.37 x 0.32 mm in size (Plate 1, figures 2-4, Plate 2, figures 1-2). Seed coat is bitegmic, 2-3 layered, measuring 17 to 20  $\mu\text{m}$  in thickness (Plate 2 figures 1, 4). Outer testa is double layered consisting of thick walled parenchymatous cells, 10 to 12  $\mu\text{m}$  thick. Inner tegmen is prominent, single layered, 6-8  $\mu\text{m}$  thick, made up of thin walled parenchymatous cells. The mature seed shows two cotyledons with ill-preserved dicot embryo (Plate 1, figure 4, Plate 2 figure 1). Each seed shows its attachment towards basal part of the fruit on central axis by their placental stalk indicating its basal placentation (Plate 2, figure 1). At the junction of locules at the basal part a distinct stele is present in the central axis. It consists of central parenchymatous pith and three arms of endarch and collateral type of vascular bundles (Plate 2, figures 6-7).

## DISCUSSION

The present fruit is developed from bicarpellary, syncarpous ovary or two female flowers fused and formed a two flowered, two celled capsule or utricle. The fruit shows two locules with two erect mucronate beaks, pubescent, thickly clothed with spines or prickles. Each locule consists of single seed occupying complete lumen of the locule and shows basal placentation. The present fruit is compared with reported fossil capsular fruits and fruits of modern taxa.

### Comparison with fossil fruits

The present specimens are compared with fossil capsular fruits, viz. *Enigmocarpon parijai* Sahnii 1943, *Indocarpa intertrappea* Jain 1964,

## Plate 1

1-8. *Spinocarpon mohgaoense* gen. et sp. nov. 1. Oblique longitudinal section of fossil fruit shows two locules, each consists of single seed occupying complete lumen of the locule, x70. Slide no. 4. 2. L.S. of fruit in middle part showing persistent style base, x75. Slide no. 8. 3. Fruit shows two locules with two erect mucronate beaks, each locule showing persistent style base tapering to an acute point at the terminal part, x55. Slide no. 15. 4-5. Fruit at serial sections, x80. Slide no. 26. 6-7. Specimen No. 2 cut in vertical longitudinal section showing central axis and spiny pericarp, x45. Slide no. 26. 8. Longitudinal section at the middle region of living *Xanthium indicum* showing fusion of two monocarpellary flowers forming bilocular capsule armed with glochidiate spines, x05. Slide no. 26.

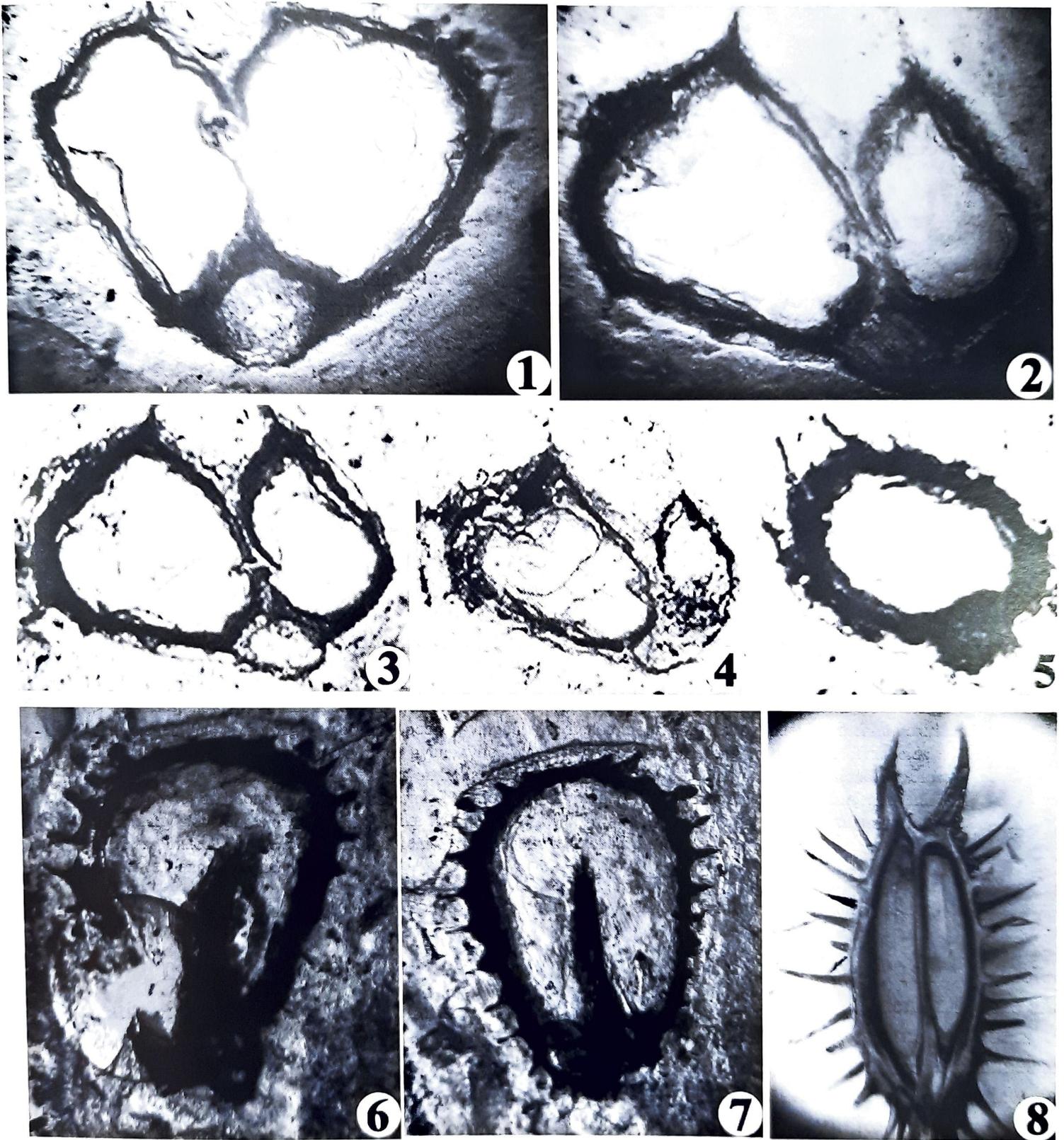


Plate 1

*Harrisocarpon sahnii* Chitale & Nambudiri 1973, *Sahnioecarpon harrisii* Chitale & Patil 1973, *Daberocarpon gerhardii* Chitale & Sheikh 1973, *Pentaloculocarpon chitaleii* Kapgate & Kapgate 1999, *Lytherocarpon mohgaonense* Kapgate et al.

2003, *Chitaleocarpon intertrappea* Kapgate 2006. All these are multilocular and many seeded capsules while the present fruit is spiny, bilocular with one seed in each locule. It is also different from unilocular one seeded *Boehmeria intertrappea* (Ambwani et al.

2004) and unilocular multiseeded *Deccanocarpon arnoldii* (Paradkar 1975), *Centrospermocarpon chitaleyi* (Sheikh & Khubalkar 1982) and *Wingspermocarpon mohgaoense* (Sheikh & Kapgate 1984). It is also different from trilobular capsular fruits such as *Euphorbiocarpon drypeteoides* (Mehrotra et al. 1983), *Phyllanthocarpon singhpurii* (Mistri et al. 1992), *Surangeocarpon mohgaoense* (Kapgate et al. 2005), *Pantocarpon deccanii* (Kapgate et al. 2007). All the above are with three functional locules with 1-2 seeds in each locule. *Linnophyllocarpon surangei* (Kolhe et al. 2009) is bilocular with many smooth seeds, while the present fruit is spiny, bilocular with one seed in each locule. Hence the present fruit does not show exact similarity with any of the reported fossil fruit.

### Comparison with fruits of modern taxa

The fruit is compared with the bilocular fruits of living families (Rendle 1971, Gamble 1957, Cooke 1958, Hooker 1961, Lawrence 1969, Saldanha & Nicolson 1978, Mathew 1983). The present fruit shows similarities with Convolvulaceae (genus *Jacquemonitia* Choisy) in two celled indehiscent capsule but mainly differs in two glabrous and winged seeds in each locule. It is also compared with families Scrophulariaceae, Gesneriaceae, Bignoniaceae, Pedaliaceae, etc. (Rendle 1971, Gamble 1957, Cooke 1958, Hutchinson 1959, Mathew 1983) which have bilocular fruits with loculicidal and septicial dehiscence. Family Scrophulariaceae, with the genus *Angelonia* Humboldt & Bonpland, resembles in minute, 1.5 mm, two celled hairy capsule but differs in glandular hairs on pericarp and persistent calyx. Families Apocynaceae, Asclepiadaceae, Loganiaceae, Gentianaceae (Hooker 1961, Lawrence 1969, Mathew 1983) also have bilocular fruits but only genus *Pergularia* Linn. of Asclepiadaceae resembles in soft achinate fruit but

differs in paired follicles, 6 x 2 cm size and seeds with fringed wing.

Family Lamiaceae resembles with the genus *Hyptis*, *Pogostemon* and *Teucrium* in bilocular hairy fruits but two nutlets and two aborted rudimentary seeds in their fruits could not be compared with the present fruit. Apiaceae also differs in having two indehiscent mericarp separated by forked corophore. Urticle fruits of series Curvembry were also compared. *Chenopodium* L. and *Salicornia* L. of Chenopodiaceae resemble in urticle with minute seeds having hooked bristles. But mainly differs in having urticle enclosed in connivent herbaceous tepals and membranous epicarp. Genus *Celosia* L. of family Amaranthaceae resembles in two celled indehiscent fruit with persistent style elongating in fruit, but presence of 4 – 8 hairy, glabrous seeds in each fruit could not be compared with present specimen. *Urena lobata* Linn. of family Malvaceae shows resemblance in indehiscent fruits covered with glochidiate spiny pericarp, but pentalocular capsule covered with blunt spines; each spine having two straight bristles pointing downwards at an angle from the apex take it apart from the present fruit.

*Synedrella nodiflora* Gaertner of the family Asteraceae resembles in small, spiny fruit but differs in lanceolate, winged fruit ending in two scaly awns above. Morphology of the present fruit closely resembles with the genus *Xanthium* Linn. of Asteraceae in having hard and tough two achenes enclosed in prickly hispidulous envelope forming an urticle and oval to oblong shape of the fruit. Outer epicarp forms pointed spines. Persistent style-base tapering to an acute point seen at terminal part of the locule (Plate 1, figure 8). It differs only in fruit size and length of spines. In *Xanthium*, fruits are 20-25 mm in length and 5-7 mm broad and spines are 2-5 mm long whereas present fruit measures 0.950 x 0.825 mm in size and spines are 60-75  $\mu\text{m}$  long.

### Plate 2

1-7. *Spinocarpon mohgaoense* gen. et sp. nov. 1. A single seed occupying complete lumen of the locule. Thin seed coat seen free from inner endocarp at places, x85. Slide no. 12. 2. One of the locule showing persistent style base, tapers to an acute point, x90. Slide no. 21. 3. Magnified view of the apical end of the locule, x250. Slide no. 22. 4. Magnified part of the fruit wall showing outer spiny pericarp and inner thin seed coat free from pericarp, x400. Slide no. 24. 5. Pericarp shows outer smooth epicarp, middle hard mesocarp and inner smooth endocarp, x310. Slide no. 55. 6. Axis cut oblique longitudinally showing pitting on vascular elements, x140. Slide no. 27. 7. Fruit axis cut transversely showing central parenchymatous pith surrounded by vascular tissue, x140. Slide no. 21.

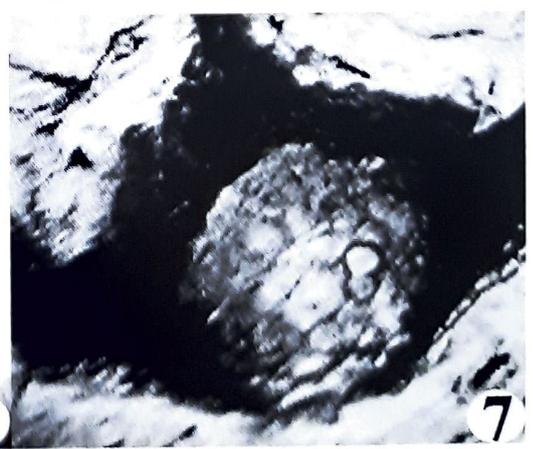
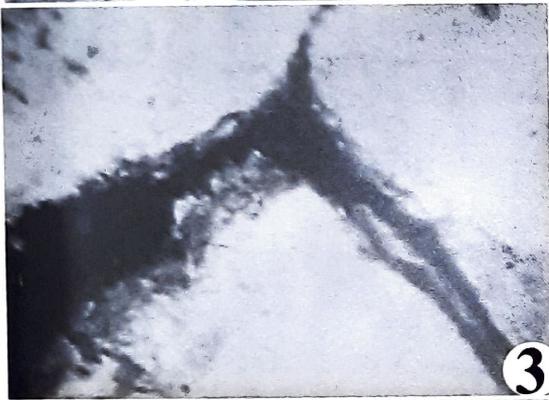


Plate 2

It does not resemble to any other previously described fossil fruits from India and abroad. Since the fossil fruit shows nearest resemblance with the spiny fruits of *Xanthium* of family Asteraceae, except in size, it is named as *Spinocarpon mohgaense* gen. et sp. nov. The generic name refers to the spiny nature of fruit and the specific epithet refers to its locality of occurrence.

**Distribution:** The genus *Xanthium* Linn., of family Asteraceae, consists of four species distributed in India, Assam, Malaysia, Sumatra, Java and other warmer parts of the world (Cooke 1958, Hooker 1961, Lawrence 1969, Mathew 1983).

**Holotype :** DK K /Ang. Sl. Nos. 1 to 35, Botany Department, J. M. Patel College, Bhandara, India.

**Locality:** Mohgaonkalan, Chhindwara District, Madhya Pradesh.

**Horizon and age:** Deccan Intertrappean beds, Late Cretaceous-Early Eocene.

### ACKNOWLEDGEMENT

The author is grateful to the University Grants Commission, New Delhi for awarding a major research project "Palaeovegetation, palaeophytogeography and palaeoenvironmental study of central India". The author is also thankful to Dr. V. P. Dhorme, Principal, J. M. Patel College, Bhandara for providing necessary laboratory facilities.

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