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Fossil fruit of *Mangifera* (Mango) from the late Cenozoic sediments of Mahuadanr Valley, Jharkhand and its phytogeographical implications

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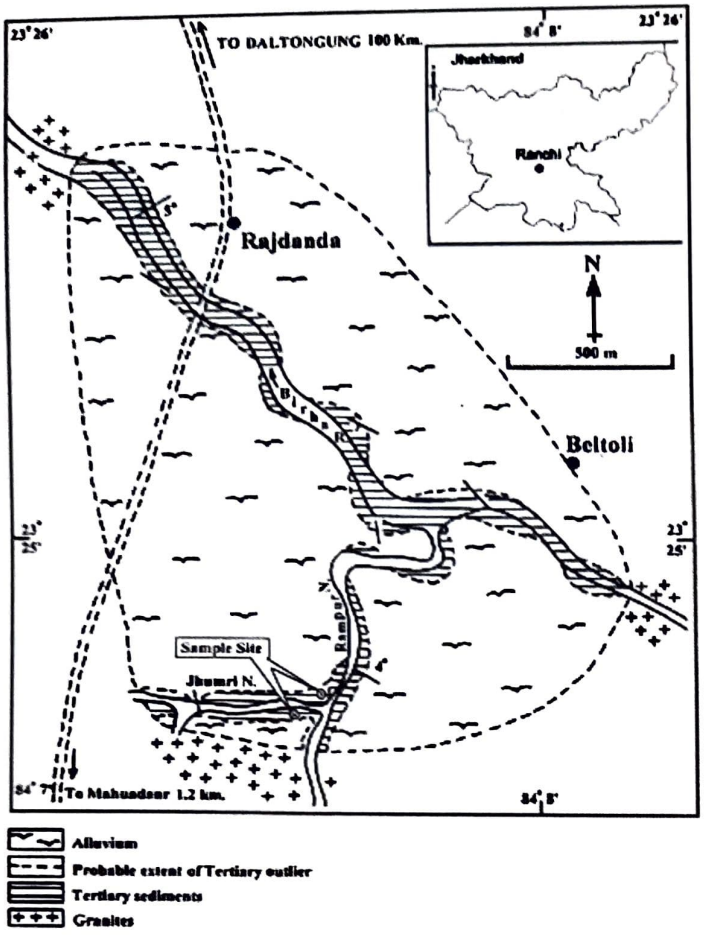
ABSTRACT

Study on the plant megafossils collected from the Mahuadanr Valley has been recently carried out which reveals the occurrence of a new fossil fruit. The detailed morphological and anatomical features (oval to elliptic shape, divisible into three part, outer thin exocarp, middle mesocarp and inner endocarp) exhibited by the present fossil fruit closely resembles the phytogeographically important taxon *Mangifera indica* Linn. of family Anacardiaceae and described here as *Mangifera mahuadanrensis* n. sp. The fossil record of *Mangifera* indicates that this genus originated elsewhere during early Cretaceous like most other angiospermous taxa and diversified in India before Paleocene and flourished luxuriantly in different parts of India. Present day distribution of the modern comparable species of the fossil fruit show that it is found to grow in tropical Asia and is well distributed in the mixed deciduous forests of the Himalayan foot hills, central India as well as in the adjoining area of the Mahuadanr Valley, Jharkhand. It suggests that such type of forest was flourishing in and around the fossil locality during the late Cenozoic and also growing at recent times.

Key words: Anatomy, fossil fruit, Jharkhand (India), late Cenozoic, *Mangifera*, Morphology, Phytogeography.

INTRODUCTION

The fossil locality, Mahuadanr Valley (23°24'00" – 23°27'30"N, 86°06'20" – 84°09'10"E) lies in the Latehar District of the Chhota-Nagpur plateau region of Jharkhand. The sedimentary sequence in this valley is developed on the basement of granite and gneisses which are exposed over a length of about 2.6 km and a width of 1.5 km along the Birha River and its tributaries. The sedimentary sequence is composed of conglomerate at the base succeeded by sandstones and shale beds. Only shale beds yielded plant fossils represented by leaf, fruit and flower and impressions of seeds. An assemblage of taxa based on both macro and micro fossils has been recorded from the late Tertiary sediments exposed all along the Birha River and its tributary, Jhumari and near Rajdanda Village of Mahuadanr Valley (Prakash et al. 1988, Bande & Srivastava 1990, Srivastava & Bande 1992, Srivastava et al. 1992, Srivastava & Srivastava 1998, Srivastava 1998, Singh & Prasad 2007, 2008, 2009, Singh & Chauhan 2008a, 2008b). Out of a large collection of fruit and leaf impressions from shale beds exposed on the left bank of Rampur Nala near the junction of Jhumari Nala in Mahuadanr Valley (Text-Figure 1) a well preserved partially petrified fruit has been identified that resembles modern fruit of *Mangifera indica* Linn. (Mango) of the family Anacardiaceae. Mango (*Mangifera indica*) is famous as an important edible



Text-Figure 1. Map showing study area.

Text-Figure 2. Field photograph showing fossil locality from where fruit was recovered.

fruit and its stem is commercially used as timbers in many parts of the world. Owing to its economic importance both for fruits as well as timbers and their range of distribution, it has got substantial interest to trace its origin and biogeography. In the present contribution, the fruits of fossil and extant mango have been studied in detail and their phytogeographical implications have been discussed.

MATERIAL AND METHODS

The material studied here was collected from the late Cenozoic sediments of Birha River and its tributary Jhumari Nala (84°06'20"E; 23°23'30"N).The fossil location is easily approachable by road from Mahuadanr Village situated on the road connecting to Daltenganj (Text-Figure1). The fossil fruit was preserved within brown shales (Text-Figures 2-3) with poorly preserved organic matter. The specimen was studied morphologically with the help of a low power microscope under reflected light. Its identification has been done through the consultation of pertaining literature as well as the fruits of extant taxa kept at the Central National Herbarium, Sibpur, Howrah, West Bengal. The micro slides of both fossil fruit and extant fruit of *M. indica* Linn. have been prepared for comparative anatomical study. The photographs of both fossil and modern comparable fruits were taken by digital camera attached to a microscope. The photographs of comparable fruit of extant species have also been provided along with the fossil to show their close resemblance. All the figured specimens, slides and their photographs are kept in the Museum of Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow.

SYSTEMATICS OF FOSSIL FRUITS

Division – Angiospermae

Order – Sapindales

Family – Anacardiaceae

Genus – *Mangifera* Linn.

Mangifera mahuadanrensis Singh, Prasad & Kumar sp. nov.

(Plate 1a, c, d, f)

Diagnosis: Drupe type fruit with oval to elliptic shape, divisible into exocarp, mesocarp, and endocarp with a seed. Endocarp is characterized by the presence of several groups of starch cells among the thin parenchymatous tissues.

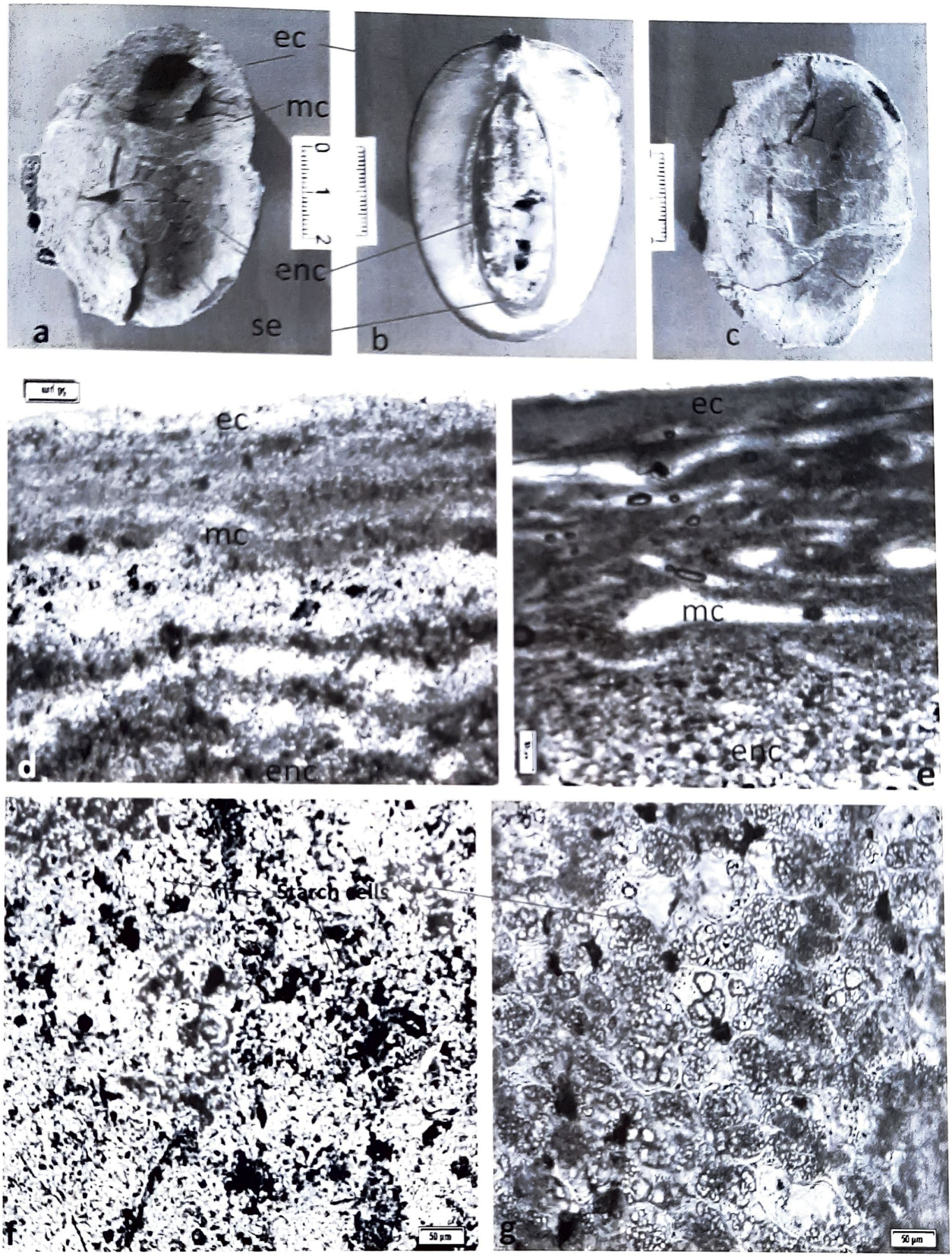


Plate 1

Figs. a,c. *Mangifera mahuadanrensis* n. sp. - Fossil fruit (splitting into two half part) showing diagnostic features *ec*, (exocarp), *mc* (mesocarp), *enc* (endocarp and *se* (seed) a. BSIP museum no. 40420 (Holotype), c. 40421 (Paratype), **Fig. b**. *Mangifera indica* - Modern fruit. **Fig. d**. Cross section of fossil fruit showing differentiation of Exocarp (ec), Mesocarp (mc) and Endocarp (enc), **Fig. e.** Cross section of modern fruit showing similarity with the fossil (d), **Fig. f.** Cross section of fossil fruit magnified to show cellular structure of endocarp and presence of group of starch cells among the parenchymatous tissues, **Fig. g.** Cross section of modern fruit magnified to show similarity in cellular structure as fossil.

Description: Fruit partially petrified, splitted into two halves, maximum length 6.7 cm and width 5.0 cm, oval to elliptic in shape, divisible into three parts, outer thin exocarp, middle mesocarp and inner endocarp with blackish coloured seed (Plate 1a, c). In cross section of the fossil fruit there is clear cut differentiation between exocarp, mesocarp, and endocarp with poorly preserved cellular structure. Exocarp is very thin and delimited on the upper most part of mesocarp. Mesocarp is divisible into two parts. Upper part comparatively thin and dense comprising usually elongated parenchymatous cells, lower part is wide and made up of interrupted and alternate bands of cellular structure having thick and thin texture (Plate 1d). Endocarp is composed of thin parenchymatous cells having groups of starch cells (Plate 1f).

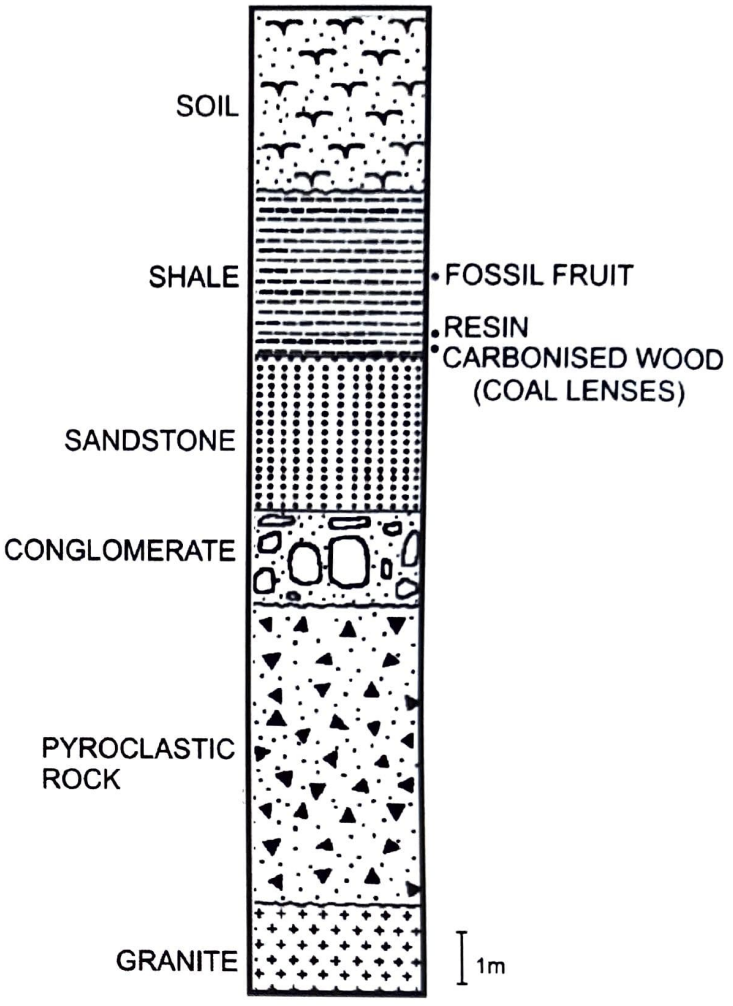
Holotype: B.S.I.P. Museum no. 40420.

Type locality: Left bank of Rampur Nala just near the Jhumari Nala, Latehar District, Jharkhand.

Age: late Cenozoic.

Etymology: Named after the Mahuadanr locality from where the fossil fruit was collected.

Affinity: In order to identify the present fruit the authors examined a large number of drupe type of fruit with the help of several published literature (Brandis 1971, Gamble 1972, Lawrence 1974, Sastri 1962). Of these, the fruits of the genus *Mangifera* of the family Anacardiaceae show very close resemblance to the present fossil fruit. Among the genus *Mangifera* Linn., the fruit of the most common species, *M. indica* Linn. comes nearest to the present fruit. However, there is also some other species of *Mangifera* known to produce similar edible fruit e.g., *M. altissima* Blanco., *M. caesia* Jack., *M. cochichinensis* Pierre., *M. foetida* Lour., *M. lagenifera* Griff. *M. longipetiolata* King., *M. microphylla* Griff., *M. oblogifolia* Hook., *M. odorata* Griff., *M. pentandra* Hook. f., *M. quadrifida* Jack., *M. reba* Pierre., *M. sylvatica* Roxb. and *M. zeylanica* Hook. f.; however, the record of fossil leaves of *M. indica* Linn. from the same fossil locality (Bande & Srivastava 1990) further suggests its affinity with the fruit of *M. indica* Linn.



Text-Figure 3. Lithocolumn of exposed section indicating the location of fruit in shale beds

DISCUSSION AND CONCLUSIONS

The palaeobotanical investigation on plant megafossils collected from late Cenozoic sediments of Mahuadanr Valley, Jharkhand, India reveal the occurrence of a new fossil fruit resembling the extant taxa, *Mangifera indica* Linn. of the family Anacardiaceae. The present fossil fruit forms its first record from late Cenozoic sediments of India. It has been described here as a new species *Mangifera mahuadanrensis*. In addition to the genus *Mangifera* Linn., a number of angiospermous taxa so far identified in earlier investigations from this region belong to the families Anonaceae, Dilleniaceae, Sterculiaceae, Urticaceae, Rutaceae, Dipterocarpaceae, Combretaceae, Fabaceae, Rhamnaceae, Rubiaceae, and Euphorbiaceae. Amongst these, the family Fabaceae is the most dominant family in the flora followed by

Rutaceae and Urticaceae, respectively. Almost all the identified taxa from late Cenozoic sediments of Mahuadanr Valley suggest that a mixed deciduous forest flourished in a tropical climatic condition.

The genus *Mangifera* consists of 69 species of tree restricted in tropical Asia (Bompard & Schnell 1997). Wild members of this genus occur in India, Sri Lanka, Bangladesh, Myanmar, Sikkim, Thailand, Cambodia, Vietnam, Laos, southern China, Malaysia, Singapore, Indonesia, Brunei, Philippines, Papua New Guinea, Solomon Islands, and Micronesia. The greatest diversity, with approximately 28 species occurs in western Malaysia, especially in peninsular Malaysia, Borneo, and Sumatra, a region considered to be the center of diversity of this genus (Lemmens et al. 1995, Bompard & Schnell 1997). Fifteen species were described in the flora of Malaya (Kochummen 1989), and about 16 species occur in Thailand (Chayamarit 1994).The occurrence of two leaf fossil species e.g., *Mangifera palaeoindica* and *M. paleocaloneura* (Sawangchote et al. 2009) in the Oligocene sediments of Thailand and two allied species of *Mangifera indica*, i.e., *M. sylvatica* Roxb. and *M. laurina* Bl. further suggest that the region might have been the center of evolution and diversification of *Mangifera indica* Linn. Fossil leaves and wood showing affinities with *Mangifera* have been found mostly from late Cenozoic deposits of south and southeast Asia (Lakhanpal & Awasthi 1984, Awasthi & Prasad 1990, Prasad 1994, Awasthi & Mehrotra 1995, Mehrotra et al. 1998). The earliest fossil species thought to be related to *Mangifera* is *Eomangiferophyllum damalgiriense* Mehrotra et al. (1998) from the Upper Paleocene of northeastern India. Thus, it may be concluded that the genus *Mangifera* originated elsewhere during early Cretaceous like most other angiospermous taxa and diversified from there in India before Paleocene and flourished luxuriantly in most parts of India.

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