

# Leaf impressions from Late Tertiary sediments of Mahuadanr Valley, Latehar District, Jharkhand, India

Sanjai K. Singh and Mahesh Prasad

Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow-226007, India  
E-mail: sanjai\_sk2002@yahoo.co.in; mahesh\_bsip@yahoo.com

## ABSTRACT

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Systematic study on the leaf impressions, collected from the Late Tertiary sediments of Mahuadanr Valley, Latehar District, Jharkhand, revealed occurrence of four species, viz. *Sweitenia mahogani* Linn., *Dysoxylum procerum* Hiern (Meliaceae), *Opilia amentacea* Roxb. (Opiliaceae) *Rhamnus purpurea* Edgew. (Rhamnaceae). These species presently grow in the mixed deciduous forests of the Himalayan foothills, Central India, South India and also in the adjoining areas of the Mahuadanr Valley. This suggests that such type of forest was flourishing in the Mahuadanr Valley during Late Tertiary and also continued to exist till date.

**Key-words:** Dicotyledonous leaf impressions, morphotaxonomy, Late Tertiary, Mahuadanr Valley, Jharkhand, India.

## INTRODUCTION

The Mahuadanr Valley is located in Chhotanagpur Plateau region of Latehar District, Jharkhand. The Late Tertiary sediments are exposed in this valley on the bank of Birha River between Rajdanda and Mahuadanr villages, about 116 km south of Daltonganj. Puri and Mishra (1982) studied geology of this area. The rock types found in the area are pyroclastics, conglomerates, sandstones and shales.

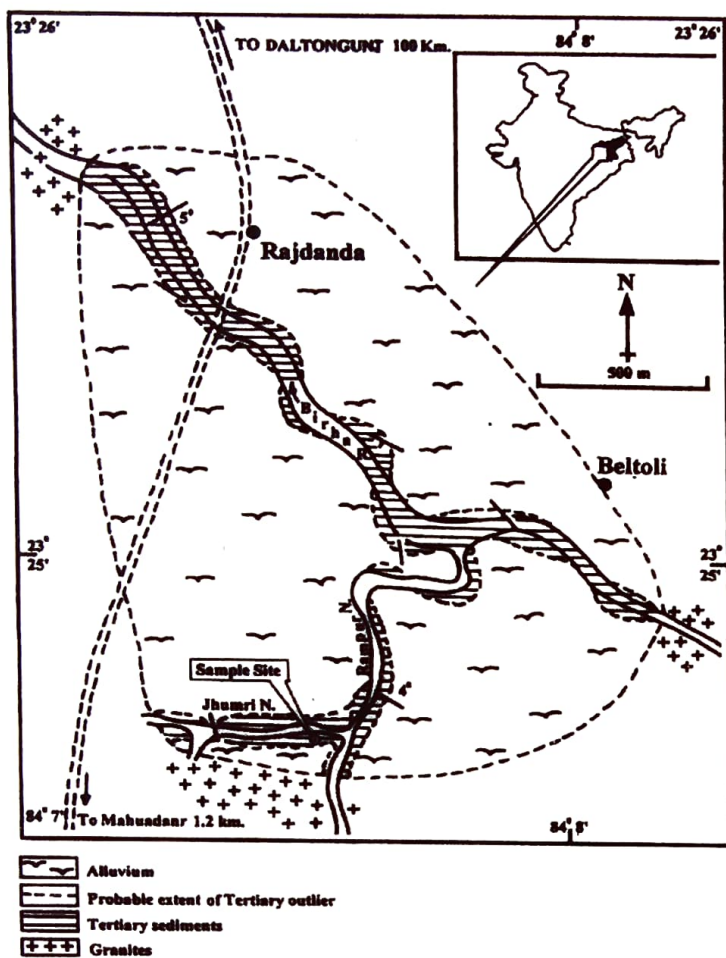
Good assemblages of mega- and microfossils were recorded from the Late Tertiary sediments exposed along the Birha River and its tributary Jhumari and near Rajdanda Village of Mahuadanr Valley (Prakash et al. 1988, Bande & Srivastava 1990, Srivastava & Bande 1992, Srivastava et al. 1992, Srivastava & Srivastava 1998, Srivastava 1998, Singh & Prasad 2007, 2008, 2009, Singh & Chauhan 2008a, b). Further study on the leaf impressions, collected from the same locality, revealed occurrence of four species, viz. *Sweitenia mahogani* Linn., *Dysoxylum procerum* Hiern (Meliaceae), *Opilia amentacea* Roxb. (Opiliaceae), *Rhamnus purpurea* Edgew. (Rhamnaceae), which are

described and discussed in the present paper.

## MATERIAL AND METHOD

Fossil leaf impressions were collected from the Late Tertiary sediments of Birha River and its tributary Jhumari Nala. The fossil locality is situated on the road connecting to Daltonganj and is easily approachable by road from Mahuadanr Village (Text-figure 1). The leaf impressions are well preserved on brown clay shale and are mostly devoid of cuticles. These were studied with the help of low power microscope under reflected light. Their identification was done with the help of herbarium sheets of extant taxa at the Central National Herbarium, Sibpur, Howrah. For describing leaf impressions, terminology published by Hickey (1973) and Dilcher (1974) has been followed. The leaf impressions are assigned to comparable extant species. The photographs of both fossil and modern comparable leaves, taken on 35 mm film with the help of Yashica Camera, are given to show their close similarity. All the figured specimens and their negatives have been deposited in the museum of the Birbal Sahni Institute of Palaeobotany, Lucknow.





Text-figure 1. Map showing area of study.

## SYSTEMATIC DESCRIPTION

**Order: Geraniales**

**Family: Meliaceae**

**Genus: *Sweitenia* Linn.**

***Sweitenia mahogani* Linn.**

Plate 1, figures 1-3

**Material:** Single, well preserved, almost complete leaf impression.

**Description:** Leaflet asymmetrical, narrow elliptic; preserved size 6.5 x 2.9 cm; apex broken; base

acute, inequilateral; margin entire; texture chartaceous, petiole preserved, 0.4 cm long, thick; venation pinnate, eucamptodromous; primary vein (1°) single, prominent, thicker in basal region, stout, slightly curved in basal region; secondary veins (2°) about 11 pairs, 0.4 to 0.8 cm apart, alternate to opposite, seemingly unbranched, angle of divergence acute, about 50°-60°, uniformly curved, inter-secondary veins present, simple, frequent; tertiary veins (3°) fine, angle of origin RR, percurrent, almost straight, branched, predominantly alternate, oblique in relation to midvein, close, quaternary vein (4°) very fine branched forming polygonal meshes.

**Affinity:** The most characteristic features of the present fossil leaf, viz. asymmetrical, narrow elliptic shape, entire margin, eucamptodromous venation, secondary veins with acute angle of divergence, suggest that this leaf belongs to the genus *Sweitenia* Linn. of the family Meliaceae. In order to find out its specific affinity, the herbarium sheets of all the available species of this genus were examined and it was found that the leaf resembles closely with the modern leaves of *Sweitenia mahogani* Linn. (C.N.H. Herbarium Sheet No. 843; Plate 1, figure 3) in shape, size and venation pattern. The fossil leaves resembling genus *Sweitenia* Linn. have been described earlier by Varma (1968) from the Siwalik sediments of Hardwar under the form species *Meliaceaephyllum mahogonites* Varma 1968.

**Present day distribution:** The genus *Sweitenia* Linn. consists of 3 species and is distributed in tropical region (Mabberley 1997). The modern comparable species, *Sweitenia mahogani* Linn., is a large tree and is distributed in Muzaffarpur, Dumka, etc. and thrives well towards Orissa, but is stunted in Chhotanagpur (Haines 1961).

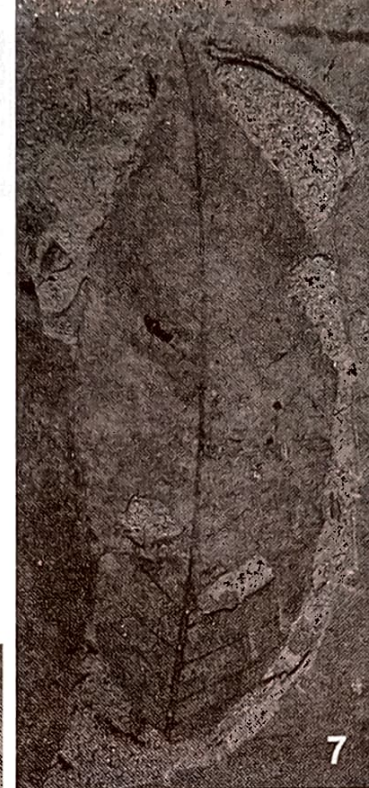
**Figured specimen:** BSIP Museum specimen no. 39864.

## Plate 1

(All figures are of natural size, unless otherwise mentioned)

1-3. *Sweitenia mahogani* Linn. 1. Fossil leaf, BSIP Museum specimen no. 39864. 2. Modern leaf. 3. Details of venation of fossil leaf, x3. 4-6. *Dysoxylum procerum* Hiern. 4. Fossil leaf, BSIP Museum specimen no. 39865. 5. Modern leaf. 6. Details of venation of fossil leaf, x3. 7-9. *Opilia amentacea* Roxb. 7. Fossil leaf, BSIP Museum specimen no. 39866. 8. Modern leaf. 9. Details of venation of fossil leaf, x3. 10-12. *Rhamnus purpurea* Edgew. 10. Fossil leaf, BSIP Museum specimen no. 39867. 11. Modern leaf. 12. Details of venation of fossil leaf, x2.5.







**Genus: *Dysoxylum* Blume*****Dysoxylum procerum* Hiern**

Plate 1, figures 4-6

**Material:** This species is represented by a single, well preserved leaf impression without its basal part.

**Description:** Leaflet asymmetrical, narrow elliptic; preserved size 9.6 x 3.9 cm; apex and base not preserved; margin entire; texture thick chartaceous; venation pinnate, eucamptodromous; primary vein (1°) single, prominent, stout, curved; secondary veins (2°) 11-12 pairs, 0.4 to 0.9 cm apart, angle of divergence acute, about 50°-65°, irregularly varies, alternate to opposite, uniformly curved towards margin, curvature pronounced near the margin, unbranched; inter-secondary veins present, simple, rare; tertiary veins (3°) poorly preserved, angle of origin RR, percurrent, almost straight to zigzag, branched, alternate to opposite, oblique in relation to midvein, close.

**Affinity:** In its shape, size and venation pattern, the fossil leaflet appears very similar to that of the *Dysoxylum procerum* Hiern of the family Meliaceae (C.N.H. Herbarium Sheet No. 79676; Plate 1, figure 5). As far as authors are aware, only two fossil leaf species of *Dysoxylum* Blume are known from the Siwalik sediments, viz. *Dysoxylum raptiensis* Prasad & Awasthi 1996 from Suraikhola, western Nepal and *D. mioklandrei* Prasad 1994 from Kathgodam, Uttarakhand. The present fossil leaflet shows closest affinity with the fossil leaf *D. raptiensis* Prasad & Awasthi.

**Present day distribution:** The genus *Dysoxylum* Blume comprises about 80 species (Mabberley 1997). *Dysoxylum procerum* Hiern, with which the present fossil shows affinity, is an evergreen tree occurring in Sikkim, Assam, Khasi Hills and Cachar and in Pegu and Tenasserim, Myanmar (Brandis 1971).

**Figured specimen:** BSIP Museum specimen no. 39865.

**Order: Santalales****Family: Opiliaceae****Genus: *Opilia* Roxb.*****Opilia amentacea* Roxb.**

Plate 1, figures 7-9

**Material:** There is a single specimen of leaf

impression with fairly good preservation.

**Description:** Leaf symmetrical, narrow elliptic; preserved size 6.8 x 2.5 cm; apex attenuate; base slightly broken, seemingly acute; margin entire; texture chartaceous; petiole broken; venation pinnate, craspedodromous to eucamptodromous; primary vein (1°) single, prominent, moderate, stout, slightly curved; secondary veins (2°) about 15 pairs, 0.2 to 0.6 cm apart, angle of divergence acute, about 55°-60°, uniformly curved up, in apical region the secondary veins join to their supradjacent secondary veins, mostly alternate, rarely sub-opposite, seemingly unbranched, inter-secondary veins not seen; tertiary veins (3°), poorly preserved, angle of origin RR, percurrent, usually straight, predominantly alternate, oblique in relation to midvein, nearly parallel near the margin and close.

**Affinity:** The diagnostic features of the present fossil leaf are narrow elliptic shape, attenuate apex, chartaceous texture, craspedodromous to eucamptodromous venation, acute angle of divergence of secondary veins and RR, percurrent tertiary veins. These features commonly occur in the extant leaves of the genus *Opilia* Roxb. of the family Opiliaceae. After critical examination of the herbarium sheets of all the available species of this genus, it is inferred that the present fossil leaf shows closest similarity with the extant leaves of *Opilia amentacea* Roxb. (C.N.H. Herbarium Sheet No. 1913; Plate 1, figure 8) in shape, size and venation pattern. As far as the authors are aware, there is no record of fossil leaf of the genus *Opilia* from Tertiary sediments of India and abroad. The present specimen forms its first fossil record from the Mahuadanr Valley, Jharkhand.

**Present day distribution:** *Opilia* Roxb. consists of 2 species (Mabberley 1997). *Opilia amentacea* Roxb. is a shrub distributed in Western Peninsula, Northern Circars, Pegu, Sri Lanka, in hot dry parts of the Thwaites Island, Tropical Australia and Africa (Hooker 1872).

**Figured specimen:** BSIP Museum specimen no. 39866



**Order: Rhamnales****Family: Rhamnaceae****Genus: *Rhamnus* Linn.*****Rhamnus purpurea* Edgew.**

Plate 1, figures 10-12

**Material:** Single, well preserved leaf impression.**Description:** Leaf simple, slightly asymmetrical near the base; size 6.1 x 3 cm; oblong; apex broken; base acute, slightly inequilateral; margin entire; texture chartaceous; petiole present, 0.7 cm long, thick; venation pinnate, craspedodromous; primary vein (1°) single, prominent, stout, almost straight; secondary veins (2°) 7 pairs, 0.3 to 1.3 cm apart, alternate to opposite, run straight towards apex, angle of divergence acute, about 40°; unbranched; tertiary veins (3°) fine, poorly preserved, angle of origin RR-AO, percurrent, straight to wavy, branched, predominantly alternate, oblique to nearly right angle in relation to midvein, close.**Affinity:** The present fossil leaf is characterized by narrow oblong shape, slightly asymmetrical, acute base, entire margin, craspedodromous venation, acute angle of divergence of secondary veins, RR-AO, percurrent tertiaries having an oblique angle in relation to midvein. A comparative study of the herbarium sheets of different families and genera shows that the above features are found commonly in the leaves of extant species, *Rhamnus purpurea* Edgew. of the family Rhamnaceae (C.N.H. Herbarium Sheet No. 88916; Plate 1, figure 11). There is no record of fossil leaf resembling the genus *Rhamnus* Linn. from the Tertiary sediments of India. This fossil leaf represents first occurrence of the species in the Late Tertiary of Mahuadanr Valley, Jharkhand.**Present day distribution:** Genus *Rhamnus* Linn. consists of about 125 species (Mabberley 1997). The modern comparable species, *Rhamnus purpurea* Edgew., is a middle sized tree distributed in the Himalaya and Western Ghats (Haines 1961) and from Marri to Kumaon at the alt. 1370 to 3050 m (Hooker 1872).**Figured specimen:** BSIP Museum specimen no. 39867.**CONCLUSION**

The present investigation on the fossil leaf assemblage revealed occurrence of four dicotyledonous species, viz. *Sweitenia mahogani* Linn., *Dysoxylum procerum* Hiern (Meliaceae), *Opilia amentacea* Roxb. (Opiliaceae) and *Rhamnus purpurea* Edgew. (Rhamnaceae) in the Mahuadanr Valley, Jharkhand during the Late Tertiary. These species presently grow in the mixed deciduous forests of the Himalayan foothills, Central India, South India and also in the Mahuadanr Valley, Jharkhand, which suggests that such type of forest was flourishing in and around the fossil locality during the Late Tertiary and is still continuing to exist.

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**REFERENCES**

- Bande M. B. & Srivastava G. P. 1990. Late Cenozoic plant impressions from Mahuadanr Valley, Palamau District, Bihar. *Palaeobotanist* 37(3): 331-366.
- Brandis D. 1971. Indian trees. 5<sup>th</sup> Impr., Bishen Singh Mahendra Pal Singh, Dehradun.
- Dilcher D. L. 1974. Approaches to the identification of angiosperm leaf remains. *Botanical Rev.* 40: 1-57.
- Gamble J. S. 1972. A manual of Indian timbers. Bishen Singh Mahendra Pal Singh, Dehradun.
- Haines H. H. 1961. The botany of Bihar and Orissa. *Bot. Surv. India, Calcutta.* Vol. I-III.
- Hickey L. J. 1973. Classification of the architecture of dicotyledonous leaves. *Amer. J. Bot.* 60: 17-33.
- Hooker J. D. 1872. The flora of British India-I. Kent.
- Mabberley D. J. 1997. The plant book. Cambridge University Press, Cambridge, U.K.
- Prakash U., Mishra V. P. & Srivastava G. P. 1988. Fossil wood resembling *Sindora* from the Tertiary of Palamu District, Bihar. *Rec. Geol. Surv. India* 18(2): 69-73.
- Prasad M. 1996. Morphotaxonomical study on angiospermous plant remains from the foot hills of Kathgodam, North India. *Phytomorphology* 44(1-2): 115-126.
- Prasad M. & Awasthi N. 1994. Contribution to the Siwalik flora from Suraikhola sequence, western Nepal and its palaeoecological and phytogeographical implications. *Palaeobotanist* 43(3): 1-42.

- Puri S. N. & Mishra V. P. 1982. On the find of Upper Tertiary- plant, fish and bird fossil near Rajdanda, Palamau District, Bihar. Rec. Geol. Surv. India 112: 55-58.
- Singh S. K. & Chauhan M. S. 2008a. Pollen remains from the Late Tertiary sediments of Mahuadanr Valley, Latehar District, Jharkhand and their climatic significance. J. Applied Biosci. 34: 152-156.
- Singh S. K. & Chauhan M. S. 2008b. Fungal remains from the Neogene sediments of Mahuadanr Valley, Latehar District, Jharkhand, India and their palaeoclimatic significance. J. Palaeontol. Soc. India 53: 73-81.
- Singh S. K. & Prasad M. 2007. Late Tertiary leaf flora of Mahuadanr Valley, Jharkhand, India. J. Palaeontol. Soc. India 52: 175-194.
- Singh S. K. & Prasad M. 2008. Fossil leaf impressions from the Late Tertiary sediments of Mahuadanr Valley, Latehar District, Jharkhand, India. Palaeobotanist 57: 479-495.
- Singh S. K. & Prasad M. 2009. Some new fossil leaves from the Late Tertiary sediments of Mahuadanr Valley, Latehar District, Jharkhand, India. J. Applied Biol. Sci. 35: 35-42.
- Srivastava A. K. & Srivastava G. P. 1998. Gall insect impression of fossil angiosperm leaf. Geophytology 26: 95-97.
- Srivastava G. P. 1998. Impact of Himalayan uplift on the Late Cenozoic flora of India. Geophytology 27: 97-102.
- Srivastava G. P. & Bande M. B. 1992. Fossil wood of *Terminalia* and *Lagerstroemia* from the Late Cenozoic beds of Mahuadanr, Palamu District, Bihar. Palaeobotanist 39: 333-337.
- Srivastava G. P., Mishra V. P. & Bande M. B. 1992. Further contribution to the Late Cenozoic flora of Mahuadanr Valley, Palamu, Bihar. Geophytology 22: 229-234.
- Varma C. P. 1968. On a collection of leaf impressions from Hardwar Beds (Shivalik Formation) near Hardwar, Uttar Pradesh. J. Palaeontol. Soc. India 5-9: 83-88.