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Record of fossil leaves of *Ziziphus* and *Lagerstroemia* from Mahuadanr Valley, Jharkhand, India and their ecological implications

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ABSTRACT

Singh SK & Prasad M 2010. Record of fossil leaves of *Ziziphus* and *Lagerstroemia* from Mahuadanr Valley, Jharkhand, India and their ecological implications. The Palaeobotanist 59(1-3) : 55-61.

A study based on the fossil leaf assemblage collected from the Late Tertiary sediments of Mahuadanr Valley revealed the occurrence of two new extant species *Ziziphus funiculosa* (Rhamnaceae) and *Lagerstroemia macrocarpa* (Lythraceae) of the Dicotyledon in the area during Late Tertiary Period. Present day distribution of these modern comparable species of the fossils indicates that both the taxa presently distributed in the moist deciduous forests of the northeast India, central and south India, which suggests that such type of forest was flourishing in and around the fossil locality during the sedimentation.

Key-words—Fossil leaf, *Ziziphus*, *Lagerstroemia*, Morphotaxonomy, Late Tertiary, Mahuadanr Valley, Ecology, Jharkhand (India).

भारत में झारखण्ड के महुआडांड़ घाटी से प्राप्त जिजिफस एवं लेजरस्ट्रोमिया वंशों के पर्ण जीवाश्म का अभिलेख और उनका पारिस्थितिक युगपत अंतर्वृद्धि

संजय कुमार सिंह एवं महेश प्रसाद

सारांश

महुआडांड़ घाटी के अंतिम टरशियरी अवसादों से एकत्रित पर्ण जीवाश्म समुच्चय पर आधारित अध्ययन से अंतिम टरशियरी काल के दौरान क्षेत्र में द्विबीजपत्री, *जिजिफस फुनीकुलोसा* (रेमनेसी) तथा *लेजरस्ट्रोमिया मेक्रोकार्पा* (लिथरेसी) की नयी प्रजातियों की उपस्थिति पाई गई है। जीवाश्मों की इन आधुनिक तुलनात्मक प्रजाति के वर्तमान वितरण से इंगित होता है कि दोनों वर्गक पूर्वोत्तर भारत, मध्य भारत तथा दक्षिण भारत के वर्तमान आर्द्र पर्णपाती वनों में वितरित हैं जिससे प्रस्तावित होता है कि इस तरह का वन अवसादन के दौरान जीवाश्म संस्थितियों में एवं उसके आस-पास फल-फूल रहा था।

संकेत-शब्द—पर्ण जीवाश्म, *जिजिफस, लेजरस्ट्रोमिया,* आकारवर्गिकी, अंतिम टरशियरी, महुआडांड़ घाटी, पारिस्थिति विज्ञान, झारखण्ड, भारत।

INTRODUCTION

THE Mahuadanr Valley is famous for the occurrence of Late Tertiary exposures containing a variety of well preserved leaf, fruit and seed impressions. It is situated in the Chotanagpur Plateau region of Latehar District, Jharkhand. The exposures are located on the bank of Birha river between Rajdanda and Mahuadanr Village (84º 06'N: 23º 23' E) about 116 km south of Daltenganj in Jharkhand. Puri and Mishra (1982) studied the geology of this area. The rocks are composed of pyroclastic, conglomerates, sandstone and shales.

A good assemblage of taxa based on mega- and micro-fossils were recorded from Late Tertiary sediments exposed all along the Birha river and its tributary, Jhumari near Rajdanda Village of Mahuadanr Valley (Bande & Srivastava, 1990; Prakash *et al.*,1988; Srivastava & Bande, 1992; Srivastava *et al.*,1992; Srivastava & Srivastava, 1998; Srivastava, 1998; Singh & Prasad, 2007, 2008, 2009; Singh & Chauhan, 2008a, b). Further study based on the leaf impressions collected from same locality revealed the occurrence of two new taxa *Ziziphus funiculosa* and *Lagerstroemia macrocarpa* of the family Rhamnaceae and Lythraceae respectively which have been described and discussed in the present communication.

MATERIAL AND METHODS

The material discussed here was collected from the Late Tertiary sediments of Birha river and its tributary Jhumari nala. The fossil location is easily approachable by road from Mahuadanr Village situated on the road connecting to Daltanganj. The fossil leaf impressions are well preserved on brown clay shales and mostly devoid of cuticles. The specimens were studied under low power microscope with reflected light. Their identification has been done through the consultation of a number of herbarium sheets of extant taxa at the Central National Herbarium, Sibpur, Howrah, West Bengal. The terminology given by Hickey (1973) and Dilcher (1974) has been followed for the description of leaf impressions. The assignment of these identified leaf impressions has been done after the name of comparable extant species to avoid any taxonomical problem. The photographs of both fossil and modern comparable leaves were taken on 35 mm coloured film with the help of Yashica Camera. The photographs of comparable leaves of extant species have also been put along with the fossil to show their close similarity.

All the figured specimens and their negatives are preserved in the Museum, Birbal Sahni Institute of Palaeobotany, Lucknow.

MAGNOLIOPSIDA

Order—ROSALES

Family—RHAMNACEAE

Genus—ZIZIPHUS Mill.

Ziziphus funiculosa Ham.

(Pl. 1.1)

Material—Single leaf impression is present in the collection.

Description—Leaf simple, symmetrical, narrow elliptic to lanceolate; preserved size 13.3 x 5.8 cm; apex attenuate; base broken; texture chartaceous; margin almost entire; venation pinnate, acrodromous, perfect; primary veins (1º) three, two lateral and one mid primary, most probably arising from base; lateral primary uniformly curved up and reached near the apex, mid primary stout, straight; secondary veins (2º) 2-3 pairs of prominent secondaries arising from mid primary, the other secondaries arising from mid primary are weak and uniformly curved up and join to lateral primary, the lateral primary also gives off secondaries, toward margin which run upwards and join to their superadjacent secondary, 1.0-1.5 cm apart, angle of divergence 40º-45º, narrow acute, unbranched; tertiary veins (3º) fine, fairly preserved, angle of origin usually RR, percurrent, straight to sinuous, sometimes branched, usually right angle in relation to primary veins, predominantly alternate and close.

Specimen—B.S.I.P. Museum No. 39761.

Affinities—The diagnostic features of the present fossil leaf such as narrow elliptic to lanceolate shape, attenuate apex; entire margin, acrodromous venation and narrow acute angle of divergence of secondary veins show resemblance with the extant leaves of most of the species of the *Grewia* of family Tiliaceae and *Ziziphus* Juss. of the family Rhamnaceae. Of these, the leaves of *Grewia* differ from present fossil leaf in the nature and arrangement of secondary veins. The secondary veins in the present fossil leaf arise from mid primary are more in number and join to the lateral primary of one side. This feature was not found in the exant leaves of *Grewia*. On a critical examination of all the available species of the genus *Ziziphus* Juss. it has been concluded that the leaves of *Ziziphus funiculosa* Buch-Ham. ex M.A. Lawson (C.N.H. Howrah Herbarium Sheet No. 507, Pl. 1.2) show closest similarity in shape, size and venation pattern.

Eight fossil leaves showing resemblance with the genus *Ziziphus* are known from the Tertiary sediments of India and Nepal. They are *Ziziphus siwalicus* Lakhanpal (1966) from Jawalamukhi in Himachal Pradesh, *Ziziphus indicus* Singh and Prakash (1980) from Arunachal Pradesh, *Ziziphus champarensis* Lakhanpal and Awasthi (1984) from Bhikhnathoree, Bihar, *Ziziphus* cf. *Ziziphus rugosa* Prasad (1994a) from the Haridwar, Uttarakhand, *Ziziphus kathgodamensis* and *Ziziphus miocenicus* Prasad (1994b) from Kathgodam, Uttarakhand, and Koilabas area, western Nepal Prasad (1994c), *Ziziphus palaeoapetala* Antal and Prasad (1997) from Siwalik sediments of West Bengal, *Ziziphus mauritiana* Lam. from the Mahuadanr Valley, Jharkhand. Besides, the fossil fruits and woods showing close affinity with the genus *Ziziphus* are also known from Tertiary sediments of India (Guleria, 1992; Bande & Srivastava, 1990). The present fossil leaf has been compared with all the known species of the genus *Ziziphus* Mill. and observed that *Z. palaeoapetala* compares with present fossil in shape and size but differs in arrangement of secondary and tertiary veins. The secondary veins arising from mid primary vein are closely placed and the tertiary veins are oblique in relation to mid primary vein as compared to right angle in the present fossil leaf.

Present Day Distribution—The genus *Ziziphus* Mill. comprises 86 species of spiny shrubs and small tree (Mabberley, 1997) and distributed in the warm temperate and sub tropical regions throughout the world. It is frequently found in tropical America, Africa, Mediterranean region, Indo-Malaya and Australia. The comparable species *Z. funiculosa* Buch- Ham. ex M.A. Lawson is a shrub growing in the moist deciduous forests of north-east India (Bengal, Khasi Hills and Silhet) and South East Asia (Malacca, Myanmar and Borneo).

Order—MYRTALES

Family—LYTHRACEAE

Genus—LAGERSTROEMIA Linn.

Lagerstroemia macrocarpa Wall. ex Kurz

(Pl. 1.3)

Material—Single well preserved, almost complete leaf impression.

Description—Leaf simple, symmetrical; narrow elliptic, size 19 x 7.5 cm; apex slightly broken; base obtuse; margin entire; texture chartaceous; petiole 1 cm long, thick, curved; venation pinnate, eucamptodromous; primary vein (1º) single, prominent, almost straight, stout, lower half thicker than upper half; secondary veins (2º) about 12 pairs visible, 0.3-2.3 cm apart, lowest pair of secondary closely placed, usually alternate, seemingly unbranched, angle of divergence 45º-65º, narrow to wide acute, basal secondaries arise with comparatively less angle, uniformly curved up and joined to their superadjacent secondaries; intersecondary veins present, simple, frequent toward upper side; tertiary veins (3º) fine, angle of origin AO-RR, percurrent, straight to sinuous, branched, oblique in relation to midvein, predominantly alternate and close.

Specimen—BSIP Museum No. 39762.

Affinity—The characteristic features of the present fossil leaf such as symmetrical, elliptic shape, acuminate

apex, obtuse base, thick petiole, eucamptodromous venation, narrow to wide acute angle of divergence and AO-RR, percurrent tertiary veins suggest its resemblance with the extant leaves of *Terminalia coriacea* (Combretaceae), *Pseudouvaria reticulata* (Anonaceae) and *Lagerstroemia macrocarpa* (Lythraceae). A critical examination of the herbarium sheets of the above taxa shows that the leaves of *T. coriacea* differ in possessing usually closely placed secondaries with nearly right angle of divergence as compared to narrow to wide acute angle of divergence of secondary veins in the present fossil. The leaves of *Pseudouvaria reticulata* possess similar shape and size but differ in the venation pattern. The basal pair of secondary arise with comparatively more angle as well as the tertiaries arranged distantly than in the present fossil leaf. Thus, the leaves of *Lagerstroemia macrocarpa* Wall. ex. Kurz show closest affinity with the present fossil leaf in shape, size and venation pattern (C.N.H. Herbarium Sheet No. 177078, Pl. 1.4).

Eight fossil leaves resembling the genus *Lagerstroemia* Linn. have been reported from the Tertiary sediments of India. These are *Lagerstroemia patelii* from the Eocene of Kachchh, Gujarat (Lakhanpal & Guleria, 1981), from Siwalik sediments of Darjeeling District, West Bengal (Antal & Awasthi, 1993) and from Siwalik sediments of Kathgodam, Uttarakhand (Prasad, 1994c), *L. siwalica* from Siwalik sediments of Koilabas, Nepal (Prasad, 1994c) and Miocene of Neyveli Lignite, Tamil Nadu (Agarwal, 2002), *L. neyveliensis* from Miocene of Neyveli Lignite, Tamil Nadu (Agarwal, 2002), *L. Jamraniensis* from Lower Siwalik sediments of Jamrani, Uttarakhand (Prasad *et al.*, 2004), *Lagerstroemia* sp. from the Oligocene-Miocene sediments of Arunachal Pradesh (Mandaokar & Ambwani, 2005), *Lagerstroemia mioparviflora* and *L. eomicrocarpa* from Siwalik sediments of Koilabas, Nepal (Dwivedi *et al.*, 2006). *L. lanceolata* from Late Tertiary sediments of Mahuadanr Valley, Jharkhand (Singh & Prasad, 2009).

The present fossil leaf has been compared with all the known fossil leaves and observed that none of them show similarity with it. The present fossil leaf differs mainly in possessing larger size with greater number of secondary veins arising at narrow acute angle (40º-45º). The fossil leaf, *L. lanceolata* described from the same locality also differ in being smaller size (6.9 x 3.7 cm) with closely placed (4-5 mm apart) secondaries as compared to large size 19 x 7.5 cm with distantly arranged (1-1.5 cm apart) secondary veins. The fossil woods of the genus *Lagerstroemia* are also known from the Tertiary sediments of India (Harsh & Sharma, 1995; Sen & Bera, 2005).

The genus *Lagerstroemia* Linn. consists of about 53 species of mainly trees distributed in the tropical forests of Africa, Asia, Polynesia and Pacific region. The fossil comparable species *L. macrocarpa* Wall. ex. Kurz, variety of *L. flosreginae* Retz. is a large deciduous tree widely distributed in dipterocarps forests and open forests of north east India, Sri Lanka, Myanmar and Malayan region. It is also found to grow on the hills of Deccan Peninsula and Western Coast from the South Konkan southward (Hooker, 1872; Gamble, 1972).

DISCUSSION AND CONCLUSION

The present investigation on the fossil leaf assemblage recovered from the Late Tertiary sediments of Mahuadanr Valley suggests the existence of two more taxa i.e., *Ziziphus funiculosa* Buch-Ham. ex M.A. Lawson and *Lagerstroemia macrocarpa* Wall. ex. Kurz. of the family Rhamnaceae and Lythraceae. Both the taxa are presently distributed in the tropical moist deciduous forests of northeast India and South east Asian region which is suggestive of the occurrence

PLATE 1 →

(All figures are of natural size unless otherwise mentioned)

Ziziphus funiculosa Buch-Ham. Ex M.A. Lawson

1. Fossil leaf in natural size; BSIP Specimen No. 39761.
2. Modern leaf in natural size. Preserved in the C.N.H. Herbarium, Howrah.

Lagerstroemia macrocarpa Wall. ex. Kurz.

3. Fossil leaf in natural size; BSIP Specimen No. 39762.
4. Modern leaf in natural size. Preserved in the C.N.H. Herbarium, Howrah.

PLATE 1

of tropical deciduous forest during Late Tertiary Period in the region. The genus *Ziziphus* Mill. has a wide ecological range distributed in tropical to warm temperate region throughout the world. However, the genus *Lagerstroemia* Linn. is distributed in moist deciduous to evergreen forest of tropical region. Both the species are indicative of low elevation with sufficient humid condition.

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