Record of fossil fruit wing of *Shorea* Roxb. from the Neogene of Arunachal Pradesh

Compression fossils of wing or fruiting calyx comparable to those of modern *Shorea* Roxb. (Dipterocarpaceae) have been recovered from the Lower Siwalik sediments (Dafla Formation, Middle–Upper Miocene) near Pinjoli in the West Kameng district, Arunachal Pradesh. This is the first record of the occurrence of fruiting calyx of *Shorea* Roxb. from the Coenozoic sediments of India. The finding also suggests that the forest type was possibly tropical evergreen in the area during the Miocene.

Fruiting calyx is a modification of calyx, attached to the fruit and becomes permanent. In general, persistent calyx is of two types such as marcescent type (when persistent sepals shrivel and wither in appearance) and accrescent type (persistent sepals grow in size round the fruit). Samaroid fruits of *Shorea* and some other members of Dipterocarpaceae have accrescent type persistent calyx forming wings which make them buoyant.

The Siwalik Group in Arunachal Pradesh is represented as a linear belt along the foothills from border with Bhutan in the west to Roing in Dibang valley in the east. Its northern limit is defined by the Main Boundary Fault (MBF) whereas in south, the Brahmaputra Alluvium defines its boundary. The Siwalik sediments along the foothills of Arunachal Pradesh are subdivided into Lower Siwalik (Dafla Formation), Middle Siwalik (Subansiri Formation) and Upper Siwalik (Kimin Formation) exposing in reverse stratigraphic order[1]. The Lower Siwalik sediments, from where fruiting calyx compressions were recovered, are exposed on road-cutting section along Bhalukpong–Pinjoli area of West Kameng district (lying between long. 91°31′E and 92°40′E and lat. 26°54′N and 28°01′N) and are considered to be Middle to Upper Miocene in age[2]. Here, the Lower Siwalik sediments are well-indurated sandstone, shale and siltstone with plant fossils[3].

The present study is based on two well-preserved fruiting calyx compressions. The specimens were compared with their modern analogs using herbarium sheets from the Central National Herbarium (CNH), Sibpur, Howrah. Besides their morphological features, the identification of the recovered fossil specimens was confirmed on the basis of cuticular features (nature of transverse veins). For cuticular studies, compressed specimens were treated with hydrofluoric acid (48%) to isolate them from the rock matrix. The isolated cuticles were then oxidized by 50% HNO_3 followed by treatment with dilute KOH (5–10%) solution[4]. After thorough washing of treated cuticles with distilled water, they were mounted on slides with euperol and studied under compound transmitted light microscope with photographic attachment (Zeiss Axioskop 40). The original specimens and prepared slides were deposited in the repository of Palaeobotany–Palynology Section, Department of Botany, University of Calcutta.

Dicotyledons

Family: Dipterocarpaceae

Genus: *Shorea* Roxb.

Shorea mioassamica sp. nov.

Description: Wing single, linear–lanceolate, with seven prominent parallel longitudinal nerves, apical end broken, basal end seemingly obtuse, preserved length 3.2 cm and maximum width 1.2 cm; all the seven nerves running throughout its length and joining at right angle by conspicuous straight or oblique transverse veins.

Figured specimens: CUH/PPL/14 and CUH/PPL/15.

Horizon: Lower Siwalik sediments (Dafla Formation, Middle to Upper Miocene).

Locality: Road cutting section, east of Pinjoli area in West Kameng district.

Affinites: The size, shape and presence of longitudinal nerves throughout its length and transverse veins at right angle clearly indicate that the specimen is a fruiting calyx of the family Dipterocarpaceae. In order to find out its nearest affinity, the fruit wings of modern dipterocarp genera like *Parashorea*, *Anisoptera*, *Shorea*, *Dipterocarpus* and *Hopea* were critically examined (Figure 1 *a*–*e*) and found that the fossil specimen shows closest affinity with *Shorea*, especially with *Shorea robusta* Gaertn. f. and *Shorea assamica* Dyer. Finer details of fruiting calyx of these two species (average number of nerves in *S. robusta* is 10–15, the transverse veins inbetween are mostly oblique and margin of calyx is non-entire whereas in the fossil specimen and modern *S. assamica*, the number of nerves is 7–8, the transverse veins are mostly straight and margin of fruiting calyx is entire) suggest a more closer resemblance with *S. assamica* (Figure 1 *e*, *h*, *i*). Earlier, Prasad[5] had recorded a fruiting calyx resembling *Anisoptera* of Dipterocarpaceae from the Lower Siwalik sediments of Himachal Pradesh. The present fossil differs from it in shape, size and number as well as orientation of nerves. There is no record of fossil remains resembling *S. assamica* from the Neogene of Arunachal Pradesh. However, Joshi and Mehrotra[2] have reported fossil leaves having affinities with modern *S. ridleyana* King and *S. bracteolata* Dyer from the Lower Siwalik sediments of West Kameng and East Kameng districts respectively. To the best of our knowledge, there is no record of fruiting calyx of *Shorea* Roxb. from the Coenozoic sediments of India and abroad. As the fossil specimen resembles *S. assamica* and is recorded from the Miocene sediments, it is being described here as a new species, *S. mioassamica* sp. nov.

The modern comparable taxon *Shorea*, a large genus of resiniferous trees, contains about 180 species widely distributed in India, Myanmar, Sri Lanka, China, Malacca and other southeast Asian countries up to the Philippine Islands[6]. The maximum concentration of the species is met within the Malaya Peninsula. In India, *S. assamica* Dyer is restricted to Assam and *S. robusta* Gaertn. f. in northern and central India. At present *S. assamica* and *S. robusta* grow in Changlang and Kameng districts of Arunachal Pradesh[7]. *S. assamica* Dyer, which the fossil specimen resembles the most, is a large gregarious tree growing in the evergreen forests of upper Assam at the foot of Naga Hills, in Sibsagar and Lakhimpur districts[8]. Fossil leaves resembling *S. assamica* Dyer have already been reported from the Lower–Middle Siwalik sediments (Middle Mio-

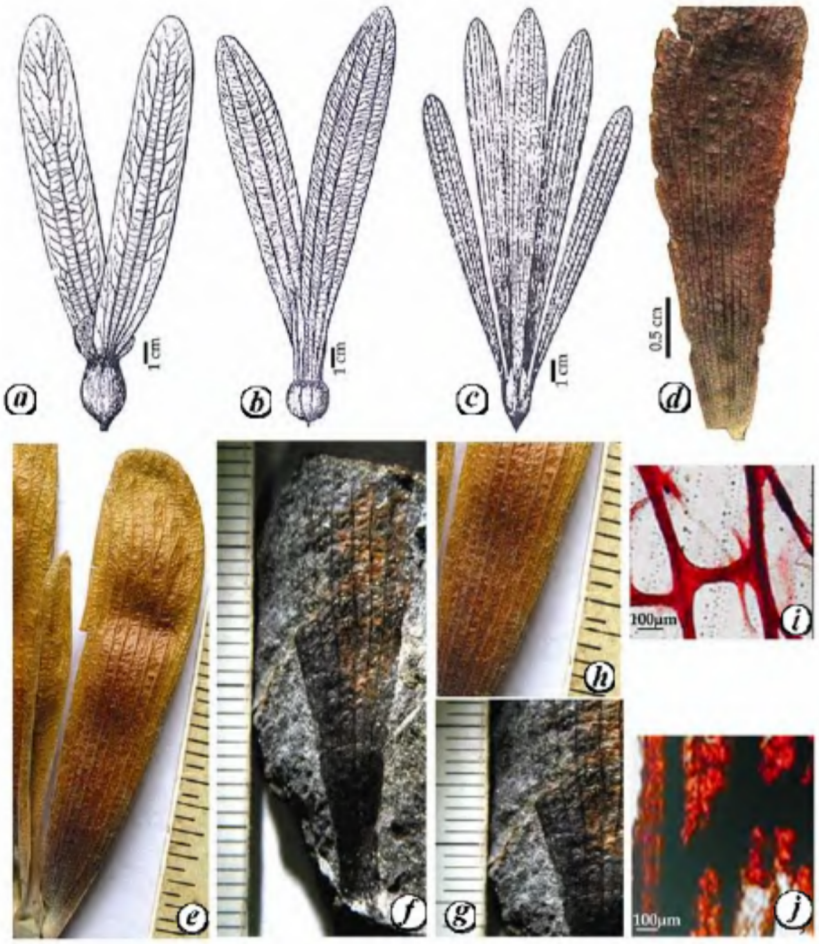

Figure 1. Modern fruit wing of ***a***, *Dipterocarpus* × 0.4; ***b***, *Anisoptera* × 0.3; ***c***, *Parashorea* × 0.4; ***d***, *Shorea robusta* × 2; ***e***, *Shorea assamica*; ***f***, Fossil fruit wing; ***g***, Fossil fruit wing showing details of nerves; ***h***, Modern fruit wing of *S. assamica* showing similar details of views; *i*, Modern fruit wing of *S. assamica* showing longitudinal nerves with straight and oblique transverse nerves (× 100) and ***j***, Fossil fruit wing with similar details of nerves (× 100).

cene–Pliocene) of Darjeeling district, West Bengal[9] and Lower Siwalik (Middle Miocene) sediments of Kathgodam, Uttaranchal[10]. The earlier and present fossil records suggest that *S. assamica* was a common forest element in tropical evergreen forests during Siwalik sedimentation (Middle Miocene–Pliocene) in India including Arunachal subHimalaya.

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