Leaf cuticles from the Neyveli lignite of India

C. L. Verma, Nirmala Upadhyay & R. K. Srivastava


The paper reports some leaf remains from the Neyveli lignite of South Arcot District, Tamil Nadu. The fossil cuticles resemble cuticles of extant *Shorea* (Dipterocarpaceae), *Cryptostegia* (Asclepiadaceae) and *Lagerstroemia* (Lythraceae).

**Key-words**—Morphology, Cuticles, *Shorea*, *Cryptostegia*, *Lagerstroemia*, Neyveli Lignite (India).

C. L. Verma, Nirmala Upadhyay & R. K. Srivastava, Department of Botany, University of Lucknow, Lucknow 226 007, India.

**MATERIAL AND METHODS**

Some of the specimens contained well-preserved leaves from which the cuticles were obtained by usual maceration method. They were mounted in Canada balsam. The numerical data are based on an average of 20 random counts. The terminology as suggested by Dilcher (1974) has been adopted.

**DESCRIPTION**

Family—Dipterocarpaceae

Genus—*Shorea* Roxb.

Fossil cuticle type-I

Pl. 1, figs 1-4; Text-fig. 1A-L

Description—Leaf hypostomatic, upper epidermal cells penta- or hexagonal, small, thick and smooth-walled, elongated on the veins (Text-fig. 1A-L).

**TEXT-Figure 1**—Fossil cuticle of *Shorea* type-I: A, Lower epidermis showing distribution of stomata and trichomes. B, Upper epidermis showing distribution of trichomes. C-H, One to many-celled peltate trichomes. I, A stoma enlarged to show guard cells and subsidiary cells. J, An enlarged portion of lower epidermis showing stomata and epidermal cells. K, Cells of veinal region. L, Cells of the upper epidermis.
VERMA et al.—LEAF CUTICLES FROM NEYVELI LIGNITE

Text-figure 1
K-L); multicellular disc-like trichomes present all over the surface (Text-fig. 1B), smaller ones having only few cells, larger ones with 50 or more cells (Pl. 1, fig. 1; Text-fig. 1C-H).

Lower epidermal cells penta-or hexagonal with slightly thickened walls, elongated round the trichomes, much elongated on the larger veins (Pl. 1, fig. 3); stomata irregular, distinct round the peltate trichomes, paracytic, frequency 110-120/mm², size 50-70 × 35-45 μm (Text-fig. 1A, 1J); trichomes all over the surface, similar to those occurring on the upper surface (Pl. 1, fig. 3; Text-fig. 1A).

Affinities with modern taxa—The important features of the fossil cuticle are: presence of peltate trichomes on both the surfaces, paracytic stomata and thick-walled, smooth epidermal cells. Both paracytic stomata and peltate trichomes occur in 16 families of Angiosperms. However, the fossil cuticle comes closest to the cuticles of extant members of Dipterocarpaceae which have varied cuticular characters but genera like Shorea and Vateria have almost identical epidermal features. Both the genera have peltate trichomes which are distributed all over the foliar surface and paracytic stomata that are confined to the lower surface. Fossil cuticle shows maximum resemblance with Shorea robusta Gaertn. f. in structure and distribution of stomata, epidermal cells and structure and distribution of trichomes. A comparative account has been given in Table 1. However, in the fossil, frequency of stomata is slightly low, size is bigger and trichomes are much crowded and have varied number of cells.

Present day distribution—Of the 12 species of the genus Shorea, five are endemic to Sri Lanka, three are confined to Burma, two grow in south India and one in Assam. S. robusta (Sal) grows now-a-days in the foot-hills of Himalaya, south India and Orissa.

Family—Asclepiadaceae
Genus—Cryptosegia Br.
Fossil cuticle type-2
Pl. 1, figs 5-8; Text-fig. 2 A-H

Description—Leaf hypostomatic, upper epidermal cells penta-or hexagonal, small, smooth-walled (Pl. 1, fig. 6; Text-fig. 2B), marginal and venal cells thickened (Text-fig. 2C), trichomes absent. Lower epidermal cells polygonal or elongated on the veins, smooth-walled, cells round the stomatal groups thick-walled (Text-fig. 2 D-F); stomata in groups, small, paracytic, bound by thick-walled cells, number of stomata in a group from 30 to 60, frequency 160-170/mm², size 20-26 × 13-20 μm (Pl. 1, figs 5, 8; Text-fig. 2A, D, G-H), trichomes absent.

Affinities with modern taxa—Amongst the important features, such as paracytic stomata in groups bound by thick-walled cells and thick- and smooth-walled epidermal cells, the fossil cuticle shows close affinity with the cuticle of modern Cryptosegia grandiflora R. Br. of Asclepiadaceae. Detailed comparison of the two is given in Table 1. In the fossil, frequency of the stomata is high and size smaller. In addition, the modern taxon has uniseriate hairs on the midrib, but such hairs have not been observed in the fossil.

Present day distribution—Genus Cryptosegia is a native of Madagascar (Gamble, 1912). Cryptosegia grandiflora, the only species, is a large climbing shrub which is now cultivated in gardens or grows wild all over India.

Family—Lythraceae
Genus—Lagerstroemia Linn.
Fossil cuticle type-3
Pl. 1, figs 9-11; Text-fig. 2 I-M

Description—Leaf hypostomatic; upper epidermal cells, penta-to polygonal with slightly

---

PLATE 1

Fossil cuticle type 1

1. Upper epidermis of fossil showing epidermal cells and pelted trichomes. * 100.
2. Upper epidermis of Shorea robusta showing epidermal cells, venal cells and pelted trichomes. * 100.
3. Lower epidermis of fossil showing paracytic type of stomata and pelted trichomes. * 150.
4. Lower epidermis of S. robusta showing pelted stomata and pelted trichomes. * 150.

Fossil cuticle type 2

5. Lower epidermis of fossil showing distribution of stomata. * 80.

6. Upper epidermis of fossil showing marginal cells. * 150.
7. Lower epidermis of C. grandiflora showing paracytic stomata arranged in groups. * 250.
8. Lower epidermis of fossil showing paracytic stomata arranged in group. * 250.

Fossil cuticle type 3

9. Lower epidermis of Lagerstroemia indica showing anomocytic type of stomata. * 300.
10. Lower epidermis of fossil showing anomocytic stomata. * 300.
sinuate walls (Text-fig. 2K), trichomes absent. Lower epidermal cells larger than the upper ones, penta-to polygonal walls, slightly sinuate, elongated and thick-walled on the larger veins (Pl. 1, fig. 11, Text fig. 2J). stomata irregular, 3 to 6 cells apart, anomocytic, frequency 80-90/mm², size 40-50 x 26-33 µm (Pl. 1, fig. 10; Text-fig. 21, L), trichomes bases rounded on the midrib only (Text-fig. 2M).

Affinities with modern taxa—Fossil cuticle is characterised by the presence of anomocytic stomata.

PLATE 1
on the lower foliar surface and epidermal cells with slightly sinuate walls. It shows similarity with the cuticle of extant genus Lagerstroemia indica L. of the family Lythraceae.

Considerable variation is found in the epidermal features of Lythraceae with respect to the nature of trichomes (Metcalfe & Chalk, 1950). The genus Lagerstroemia has also varied types of trichomes. A detailed comparison is given in Table 1. In the fossil, the frequency of stomata is low and size is bigger. On the midrib region of fossil cuticle a few hexagonal, thick-walled areas have been observed and most probably they represent hair bases. There are striaions on the upper epidermis.

Present day distribution—The genus Lagerstroemia with about 50 species is confined to the old world (Pearson & Brown, 1932). Seven species, viz., L. indica, L. parviflora, L. lanceolata, L. flo-s-riuga, L. hypoleuca, L. vilosa and L. tomentosa are found in India. L. indica with which the fossil cuticle resembles is a small deciduous tree indigenous to China. It is cultivated through out India in the gardens (Gamble, 1912).

<table>
<thead>
<tr>
<th>NAME OF SPECIES</th>
<th>LEAF</th>
<th>EPIDERMAL CELLS</th>
<th>STOMATA</th>
<th>FREQUENCY</th>
<th>SIZE IN µm</th>
<th>TRICHOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil cuticle type 1</td>
<td>Hypostomatic</td>
<td>Penta or hexagonal</td>
<td>Penta-polygonal, smooth walled</td>
<td>Irregular</td>
<td>130 120</td>
<td>50 70 x 35 +5</td>
</tr>
<tr>
<td>Living Shorea robusta</td>
<td>Hypostomatic</td>
<td>Penta or hexagonal, small</td>
<td>Penta-polygonal, smooth walled</td>
<td>Irregular all over the surface between the smaller veins</td>
<td>160 170</td>
<td>40 50 x 26 55</td>
</tr>
<tr>
<td>Fossil cuticle type 2</td>
<td>Hypostomatic</td>
<td>Penta hexagonal small, smooth walled</td>
<td>Polygonal or elongated on veins, thick walled round stomatal groups</td>
<td>In groups between veins, crowded</td>
<td>160 170</td>
<td>20 26 x 13 20</td>
</tr>
<tr>
<td>Living Cryptostegia grandiflora</td>
<td>Hypostomatic</td>
<td>Penta hexagonal, small</td>
<td>Polygonal, thin walled, thick walled round stomata</td>
<td>In groups between veins</td>
<td>140 150</td>
<td>23 26 x 16 20</td>
</tr>
<tr>
<td>Fossil cuticle type 3</td>
<td>Hypostomatic</td>
<td>Penta to polygonal, slightly sinuate walls</td>
<td>Polygonal, sinuate walls</td>
<td>Irregular</td>
<td>80 90</td>
<td>40 50 x 26 35</td>
</tr>
<tr>
<td>Living Lagerstroemia indica</td>
<td>Hypostomatic</td>
<td>Penta polygonal sinuate walls</td>
<td>Polygonal sinuate walls</td>
<td>Irregular</td>
<td>115 125</td>
<td>33 42 x 23 26</td>
</tr>
</tbody>
</table>

Text-figure 2—Fossil cuticle of Cryptostegia type 2: A, A portion of leaf cuticle showing distribution of stomata; B, Upper epidermal cells; C, Cells of the vein region; D, Stomata in groups between the smaller veins; E, Thick walled cells round the stomata; F, Cells of the midrib region; G, A portion of non-veinal region enlarged to show the stomata in groups; and H, A stomata enlarged to show the guard cells and subsidiary cells.

Fossil cuticle of Lagerstroemia type 3: I, Lower epidermis showing distribution of stomata and epidermal cells; J, Lower epidermal cells enlarged to show the sinuate walls; K, Upper epidermal cells; L, A stomata enlarged to show vertical aperture and guard cells; and M, Epidermal cells showing trichome bases.
ACKNOWLEDGEMENTS

Authors are grateful to Prof. B. S. Trivedi, former Head, Botany Department, University of Lucknow, for valuable suggestions. For financial assistance one of the authors (NU) is thankful to the C.S.I.R., New Delhi and (RKS) is thankful to the authorities of the Birbal Sahni Institute of Palaeobotany, Lucknow.

REFERENCES


