

RESEARCH ARTICLE

Study of Floral Epidermal Features in *Gmelina arborea* Roxb. (VERBENACEAE)

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ABSTRACT

Gmelina arborea Roxb. is a medium sized, unarmed, deciduous tree with whitish gray smooth bark. The plant is also important medicinal. Its flowers are showy, 2.5–3.5 cm long, brownish-yellow usually in small, opposite decussately arranged small cymes of about three flowers along the axis of a densely fulvous-hairy terminal panicles. Floral epidermal features including nature of epidermal cells, stomata and trichomes along with their dimensions of all floral parts are studied. Epidermal cells are found straight walled in peduncle, bract, stamen, carpel and fruit with cuticular striations in staminal cells, broadly sinuate in calyx, broadly and deeply sinuate in adaxial and abaxial surfaces of corolla lobes respectively. Peduncle, fruit are astomatic and bracts, calyx and corolla lobes are hypostomatic. They are anomocytic in bract, anomocytic, diacytic and paracytic in calyx and anomocytic and very occasional abaxially on corolla lobe. Trichomes are of two types non-glandular and glandular, which vary, in minute details on different parts. Unique multiseriate glandular trichomes are exclusively found on filaments. Floral trichomes are found species specific and suggestive of their functional significance.

KEYWORDS

Gmelina arborea, floral trichomes, stomata, epidermal cells, anomocytic.

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INTRODUCTION

Trichomes are reliable taxonomic markers as they are of diverse types and are diagnostic characters not only helpful in identification of particular plant species but also of crude drugs and detection of adulterants.

Solereder (1908), Netolitzky (1932); Cowan, (1950); Farooq (1963), Metcalfe and Chalk, (1950), Pant and Banerji, (1965); Inamdar (1967, 1968); Inamdar and Patel, (1973); Ramayya, (1972); Sing *et al.*, (1974); Lowell and Lucansky, (1986), Al-Shammary and Gornall (1992); Combrinck *et al.*, (2007); have provided useful information on structure, development, function and classification of trichomes in many angiospermic families. They proved more useful at generic and specific level.

In present attempt, floral epidermal features of *Gmelina arborea* Roxb. which is used in Ayurveda with its known medicinal values, is studied.

Sanskrit name: Shriparni (having beautiful leaves) Mahabhava, Pita-rohini (having yellow flowers)

Local name: Gambhari, Shivan

Large tree of height 13-20 m. Bark white leaves long and broad, heart shaped, long petioled, acuminate, with foliar nectarines. Flowers yellow, fruits oval, yellow sweet astringent.



Fig. 1: *Gmelina arborea* Roxb (Surface astomatic)

External uses: Tridoshatmak Because of cooling and soothing actions the leaves relieve burning and pain. Leaves are tied to affected part. Paste of leaves is applied on forehead in case of headache.

Internal uses: used in vertigo and as brain tonic. Fruit relieves excessive thirst, improves appetite and digestion. Used in diarrhoea, constipation and haemorrhoids. Bark used in oedema. Ripe fruit is cardiotoxic. Fruits and leaves are diuretic. Promotes breast milk. Fruits galactagogue and aphrodisiac. Bark is bitter tonic, antidote on scorpion and snake bites.

Parts used: Root, leaves, fruit. (Gogte, 2009)

MATERIALS AND METHODS

Plant material for the present study collected from various localities from Amravati and Melghat and identification is confirmed with standard Floras. To get an integrated picture of trichome types and their organographic distribution, mature floral parts including peduncle and fruits were used. Varied temporary micropreparations were made by:

- Epidermal peels
- Mounts using sodium hydroxide (aq.) and 2% acetic acid treatment
- Scrapping of trichomes
- Transverse sections.

Trichomes were stained in safranin (1% aqueous) and mounted in glycerine. For study of epidermal cells and stomata floral parts like bracts, sepals, petals were treated with 1-2% aqueous sodium hydroxide for clearing. Cleared parts were treated with 2% acetic acid and prepared peels were stained with 1% aqueous safranin followed by mounting in 50% glycerine. Quantitative analysis of stomatal complex was made by calculating stomatal frequency (Salisbury, 1927), size of stomata and epidermal cells from random samplings of 5 different peels on either surfaces in case of dorsiventral parts.

Other parameters include stomatal and epidermal cell shape, distribution and orientation were investigated. Stomatal classification is based on the present morphological classification recorded by Baranova (1992).

Observations were made under Olympus compound microscope and camera lucida sketches were made.

RESULTS AND DISCUSSION

Floral Epidermal features in surface view

PEDUNCLE

Epidermal cells:

In between angular portions, isodiametric, regular, hexagonal, 20 x 16 μ , walls – straight, end walls – oblique or straight; orientation – various to long axis of organ. Cuticular striations – absent.

Stomatal complex: Surface astomatic (Fig. 1).

Trichomes:

I. Non-glandular uniseriate filiform

Multicellular conical

Body – falcate conical, 3-celled, 200 x 22 μ , lower cells shorter, broader, terminal cell longer, acutely pointed at apex; basal cell shortest; contents-hyaline; base-simple, walls-lateral-moderate thick, smooth, concave, constricted at cross-walls, cross walls-straight, surface-smooth; lumen broad seated on epidermal cell surrounded by 5-12 adjoining epidermal cells in rosette (Fig. 2).

Body – flagellate – conical, 3-4 celled, 700 x 20 μ , much long other features similar to falcate-conical type (Fig. 37).

II. Uniseriate glandular capitates

Capitate sessile or shortly stalked:

Foot-1-celled, not sunken; stalk-1-celled, slight narrower than base of head; contents-hyaline; head-globose, 2-6 celled; contents-hyaline, fine, 32 x 20 μ (Fig. 5, 6).

BRACT

Epidermal cells:

Adaxial surface – cells elongate, small, isodiametric, 32 x 28 μ , walls-straight; orientation – longitudinal to long axis of organ. Cuticular striations – absent. (Fig. 22).

Abaxial surface – Cells similar to those of adaxial surface, slight bigger, 28 x 24 μ . Cuticular striations – absent (Fig. 21).

Stomatal complex – Surface hypostomatic.

Adaxial surface – Astomatic.

Abaxial surface – Stomatal distribution-more frequent on basal part; orientation – longitudinal to long axis of organ; shape – oval; guard cells similar to those of other parts. Type – anomocytic, adjacent cells 3-4 in number. Size – 24 x 20 μ ; frequency – 2/unit square (Fig. 20).

Trichomes:

I. Non-glandular uniseriate filiform

Multicellular conical

Body – flagellate – conical, 308 x 20 μ , similar to those of peduncle, slight differing in: Basal cells 2 in number, narrower than lower and terminal cells. Frequent adaxially and abaxially (Fig. 19).

II. Uniseriate glandular capitates

1. Capitate sessile or shortly stalked

Similar to those of stem; head-2-celled; contents – hyaline, 36 x 12 μ . Frequent abaxially (Fig. 3).

2. Peltate gland:

Foot-1-celled, not sunken; stalk-1-celled, contents – hyaline; head-peltate, multicelled, contents – hyaline, 80 x 72 μ . Frequent abaxially (Fig. 4).

CALYX**Epidermal cells:**

Adaxial surface – intercostals cells isodiametric, 68 x 40 μ ; walls – sinuate, sinuosities broad angled; orientation – various to long axis of organ; costal cells – longer than broad, straight walled, parallel to plane of vein. Cuticular striations – absent (Fig. 30).

Abaxial surface – Cells similar to those of adaxial surface, smaller, 32 x 28 μ . Cuticular striations – absent (Fig. 23).

Stomatal complex – Surface hypostomatic.

Adaxial surface – Astomatic.

Abaxial surface – stomatal distribution – all over on intercostals area; orientation – oblique, longitudinal, transverse to long axis of organ; shape-elliptic-oval; guard cells similar to those of peduncle, leaf. Distributional pattern – nonspecific, closely placed, frequently in groups of two, contiguous obliquely oriented stomata without bridge, frequent, placed 1-3 cells apart. Type – anomocytic, adjacent cells 4-6 in number; few diacytic, adjacent cells in pair equal, arched; paracytic, adjacent cells subequal, arched size – 32 x 28 μ ; frequency – 38/unit square.

Trichomes:**I. Non-glandular uniseriate filiform****Multicellular conical**

Body – falcate – conical similar to those of peduncle (Fig. 9).

II. Uniseriate glandular capitate**Sessile or short stalked**

Similar to those of bracts; head – large, peltate or spherical, glandular, contents – hyaline, 40 x 40 μ (Fig. 7, 8).

COROLLA LOBE AND TUBE:**Epidermal cells:**

Adaxial surface – polygonal, irregular with specific contents, 50 x 30 μ ; walls – broadly sinuate or wavy to nearly straight; orientation – various and longitudinal to long axis of organ. Cuticular striations – absent (Fig. 29).

Abaxial surface – isodiametric, slight elongate with contents, 50 x 30 μ ; walls – sinuate, sinuosities deeper; orientation – various and longitudinal to long axis of organ. Cuticular striations – absent (Fig. 28).

Tube – Inner cells – squarish, not much elongate, 60 x 20 μ ; walls – straight; end walls – straight and oblique; orientation – longitudinal. Cuticular striations – absent (Fig. 27).

Outer cells – similar to those of inner part, larger, elongate, 65 x 30 μ . Cuticular striations – absent (Fig. 26).

Stomatal complex – Surface astomatic mostly, occasionally hypostomatic.

Adaxial surface – Astomatic.

Abaxial surface – stomatal distribution – occasional, 1 or 2 stomata; orientation – longitudinal to long axis of organ; shape – broad, round; guard cells large, sunken by adjacent cells. Distributional pattern – nonspecific. Type – anomocytic, adjacent cells 5-6 in number. Size 30 x 28 μ ; frequency – 1/unit square (Fig. 35).

Trichomes:**I. Non-glandular uniseriate filiform****1. Unicellular conical:**

Body – ovate – conical, short or long, broad, 210 x 40 μ , obtusely pointed at apex; base – broad, bulbous; contents – granular in basal portion; wall – moderate thick, smooth. Frequent adaxially on terminal portion of lobes (Fig. 31).

2. Multicellular conical:

- Body – flagellate – conical, 250 x 25 μ , similar to those of peduncle and calyx. Frequent on tube and corolla lobe abaxially (Fig. 17).

- Body – falcate – conical, 200 x 25 μ , similar to those of calyx. Frequent on tube and lobe abaxially (Fig. 18).

STAMEN

Epidermal cells – Hexagonal, elongate; walls – straight; end walls – oblique and straight; orientation – longitudinal. Cuticular striations – present; striate distinct, running longitudinally to long axis of cells (Fig. 33).

Trichomes:**I. Non-glandular uniseriate filiform****1. Unicellular conical:**

Staminal papillae

Body – short, 30 x 40 μ , round at apex, papilloform; contents – hyaline; wall – thin, smooth. Frequent on lower portion of filament (Fig. 15).

2. Multicellular conical:

Body – falcate – conical, longer, 400 x 25 μ , similar to those of other floral parts. Frequent on lower portion of filament (Fig. 32).

II. Uniseriate glandular capitate**Capitate sessile or shortly stalked**

Foot-1-celled, not sunken; stalk-1-celled; cell squarish; contents – hyaline; head – globose, 6-7 celled, each chamber striated, 110 x 135 μ . Unique on proximal part of filament (Fig. 14).

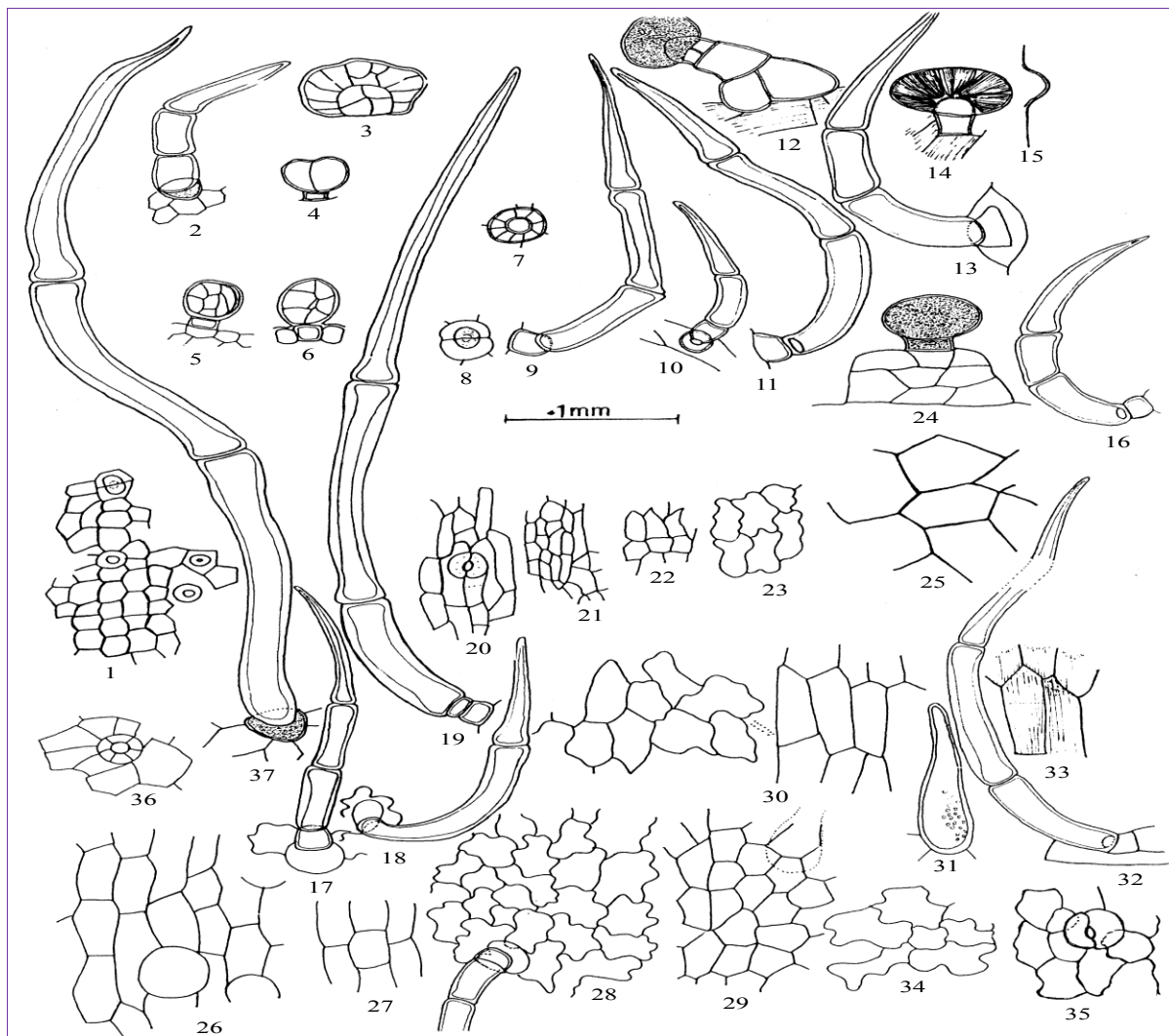
III. Multicellular glandular capitate

1. Foot-2-celled; cells unequal, larger, longer than broad, squarish, not sunken; stalk-3-celled; lower cell single, longer than broad, squarish, 45 x 90 μ ; contents – hyaline; terminal cells 2 – seriate, cells small, squarish, as long as broad, 15 μ long; contents – hyaline; head –

globose, 1-celled (chambered), contents – dense, 50 x 70 μ . Frequent on proximal part of filament (Fig. 12).

2. Foot-3-seriate or (3 tiered), 150 μ broad, cells pentagonal, not sunken; contents – hyaline; stalk-1-

celled, broader than long, short, cell squarish; contents – dense; head – globose, 1-celled; contents – dense, 135 x 100 μ . Frequent proximally on filament (Fig. 24).



Floral Epidermal Features in Surface View (Figs. 1 – 37):

1: Peduncle epidermis; **2, 37 :**Non-glandular trichomes from peduncle; **3, 4:** Capitata and peltate glandular trichomes from bract. **5-6:** Capitata glandular trichomes from peduncle; **7, 8 :** Capitata glandular trichome from calyx; **9:** Non-glandular trichome from abaxial surface of calyx; **10, 13:** Non-glandular trichomes from outer part of corolla tube; **11:** Non-glandular trichome from inner part of corolla tube; **12, 14, 24:** Capitata glandular trichomes from filament with bicelled and multicelled base; **15:** Papilla from filament; **16:** Non-glandular trichome from top of fruit; **17, 18:** Non-glandular trichomes from abaxial surface of corolla lobe; **19:** Non-glandular trichomes from abaxial surface of bract; **20-21:** Bract abaxial epidermis and stomata, **22:** Bract adaxial epidermis; **23-** Calyx abaxial epidermis; **25:** Fruit epidermis; **26:** Outer part of corolla tube showing epidermis; **27:**Inner part of corolla tube showing epidermis; **28:**Corolla lobe abaxial epidermis; **29:** Corolla lobe adaxial epidermis near tube portion; **30:**Calyx adaxial epidermis, straight walled cells of lobe and sinuous cells in between lobes; **31:**Non-glandular trichome from adaxial surface of corolla lobe; **32:**Non-glandular trichome from filament; **33 :** Filament epidermis showing cuticular striations; **34:**Corolla lobe adaxial epidermis; **35:** Corolla lobe abaxial epidermis showing occasional stoma; **36:**Capitata glandular trichome from adaxial surface of corolla lobe.

CARPEL

Epidermal cells – Polygonal, irregular; walls – thick, straight; orientation – longitudinal. Cuticular striations – absent.

Trichomes:**Non-glandular uniseriate filiform****Multicellular conical:**

Body – falcate – conical, 375 x 25 μ , similar to those of other vegetative and floral parts. Frequent on terminal part of ovary and style.

Fruit

Epidermal cells – Polygonal, irregular, 80 x 75 μ ; walls – thick, straight; orientation – various to long axis of organ. Cuticular striations – absent (Fig. 25).

Stomatal complex – Surface astomatic.

Trichomes:**Non-glandular uniseriate filiform****Multicellular conical:**

Body – falcate – conical, 350 x 25 μ , similar to those of vegetative and floral parts. Frequent on terminal portion.

Detailed descriptions of trichomes are available in the literature for many commercially important genera (Sharma *et al.*, 2003). The distribution and structure of trichomes on plant surfaces contribute to the control of transpiration and temperature of organ. Trichome density afford the organ protection (Bosabaldis, 2002). Trichomes function in plant defence or act as attractants to facilitate pollination (Weiss, 1997).

CONCLUSION

Hence floral trichomes are suggestive of their functional significance. They differ in their details and are special and typical for particular taxon and particular organ and surface. In present study some specific additional types are found. These trichomes are very specific for particular species.

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