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SEM STUDIES OF PETAL STRUCTURE OF COROLLA OF THE SPECIES *SIBBALDIA* L. (ROSACEAE)

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Abstract

Epidermal micromorphology of petals of 8 species of *Sibbaldia* L., of the family Rosacceae has been studied by Scanning Electron Microscope. Micromorhological characters observed in petals and their reliability as a taxonomic marker is discussed. The petal epidermal cells exhibit definite geometrical patterns, where cell wall boundaries are usually raised, cell surface is marked with striae, which are ruminate at the projection. Stomata were completely absent in the epidermis of the petals. The taxonomic significance of petal structure in the identification and elucidation of species affinity and relationship is discussed.

Introduction

Taxonomical\y *Sibbbaldia* L., belongs to the family Rosaceae, Sub-family Rosoideae, tribe Potentillae Hutchinson, (1964). It comprises of about 10 herbaceous species mostly distributed in South East Asia (Tahir & Rajput, 2009; Rajput & Tahir, 2008). The sepals and petals resemble leaves in their internal structure. They consist of ground Parenchyma, a more or less branched vascular system and an epidermis, (Essu, 1976). The color of petals, plays an important role in making the flowers attractive to biotic pollinators. The petal bases contains flavonol glucosides which absorb ultraviolet light and make petal bases distinguishable as nector guides to appropriate insect pollinators, (Thompson, 1972). Petals of the flowers show a variety of ultraviolet reflectance pattern. These pattern differentiate closely related taxa and can be of diagnostic value in taxonomy, (Horovitz, 1972).

The epidermis of both sepals and petals may have stomata and trichomes. The stomata on petals either resemble those on leaves or may be of different type. Epidermal cells form a continuous layer on the surface of the organ. They show various special characteristics related to their superficial position.

The floral part has been the object of many studies with regards to their structure, organography, and ontogeny (Barnard, 1961; Arber, 1950; Carlquist, 1969 and Kaussmann, 1963). No micromorphological studies of petals, with SEM has been carried out. In this investigation the micromorphological details of petals of all the species of *Sibbaldia* has been examined by Scanning Electron Microscope.

Materials and Methods

The samples of petal were obtained directly from the herbarium specimen, belonging to 8 species of *Sibbaldia* collected from different geographical regions. Most of the material used in this study was obtained from the herbarium sheets lodged at the Arnold Arboretum of Harvard University, U.S.A and Royal Botanic Garden, Kew London. The detail of the voucher specimen is provided in appendix.

For the SEM studies of Petal structure of corolla of the species *Sibbaldia* L. (Rosaceae), complete petals of corolla were taken and attached onto the stub with double-

sided adhesive tape from adaxial surface. The samples were coated with 30Aº gold in a Polavon Sputter coater and were examined with Jeol JSM-T20 Scanning Electron Microscope, at an accelerating voltage of 20KV. For this investigation 3-4 samples of petals, from each species were examined and only one voucher is cited in the appendix. The terminology used to describe the pattern or cell shape is that of Stearn (1983) and Barthlott (1981).

Micromorphological description of Petals

***S.adpressa* Bunge:** The petal surface cells are distinct and loosely packed. The cell exhibiting striate to ruminate pattern. Striate are thick and condensed in the centre into small projections of irregular shapes giving appearance of folds and finger-like processes. (Fig. 1A-B)

***S.micropetala* (Don) Hand-Mazz:** The petal surface of this species exhibit closely packed epidermal cells. The cell surface raised into broad finger-like projections or tubercles, some times flattened into folds. The surface as a whole shows striate pattern except the top of the projections or tubercles where the striate are parallel and are of ruminate pattern (Fig. 1C-D).

***S. purpusilloides* (Smith) Hand-Mazz:** The petal epidermal surface exhibit compact thin walled cells more or less circular in outline, central part of each cell is raised into a fold surrounded by thick elevated boundaries. Each cell surface is marked with striae, condensed into the central folds. Petal epidermal surface shows a scally pattern in lower magnification (Fig. 1E-F).

***S.procumbens* Linn:** The epidermal cells on petal surface are of different size and arrangement; closely packed with lightly raised cell walls. The surface between cell walls exhibit ruminate pattern, that run through the central part of the two adjacent cells diminishing separating walls. The elevated radial walls also shows ruminate pattern (Fig. 1E-F).

***S. purpurea Royle*:** The epidermal cells of petal surface are closely packed with distinct revolate outline with rugose-tuberculate surface pattern. The surface between revolate radial walls exhibits striate pattern, which is condensed in the central fold or tubercle giving ruminate appearance.

This species of *Sibbaldia*, exhibit some sort of folds and sculpture on the epidermal cells of petal surface as in S. *sikkimensis* (Fig. IG-H)

***S.sikkimensis* (Prain) Chatterjee:** The epidermal cells of the petal surface closely packed with distinct outline, showing rugose tuberculate pattern. The surface between radial walls of each cell exhibit straite pattern, the central part of the cells are raised into small irregular projection giving appearance of folds. The striae are condensed forming ruminate pattern on the folds (Fig. 2A-B).

***S. unguiculata* Rajput & Tahir:** The petal surface of this species have Rugose-tuberculate pattern. The epidermal cells are closely packed with distinct smooth cell walls. The surface of each cell exhibiting striate to ruminate pattern and raised into projections of different shapes, some are finger-like and others raised as V-shaped folds (Fig. 2C-D).

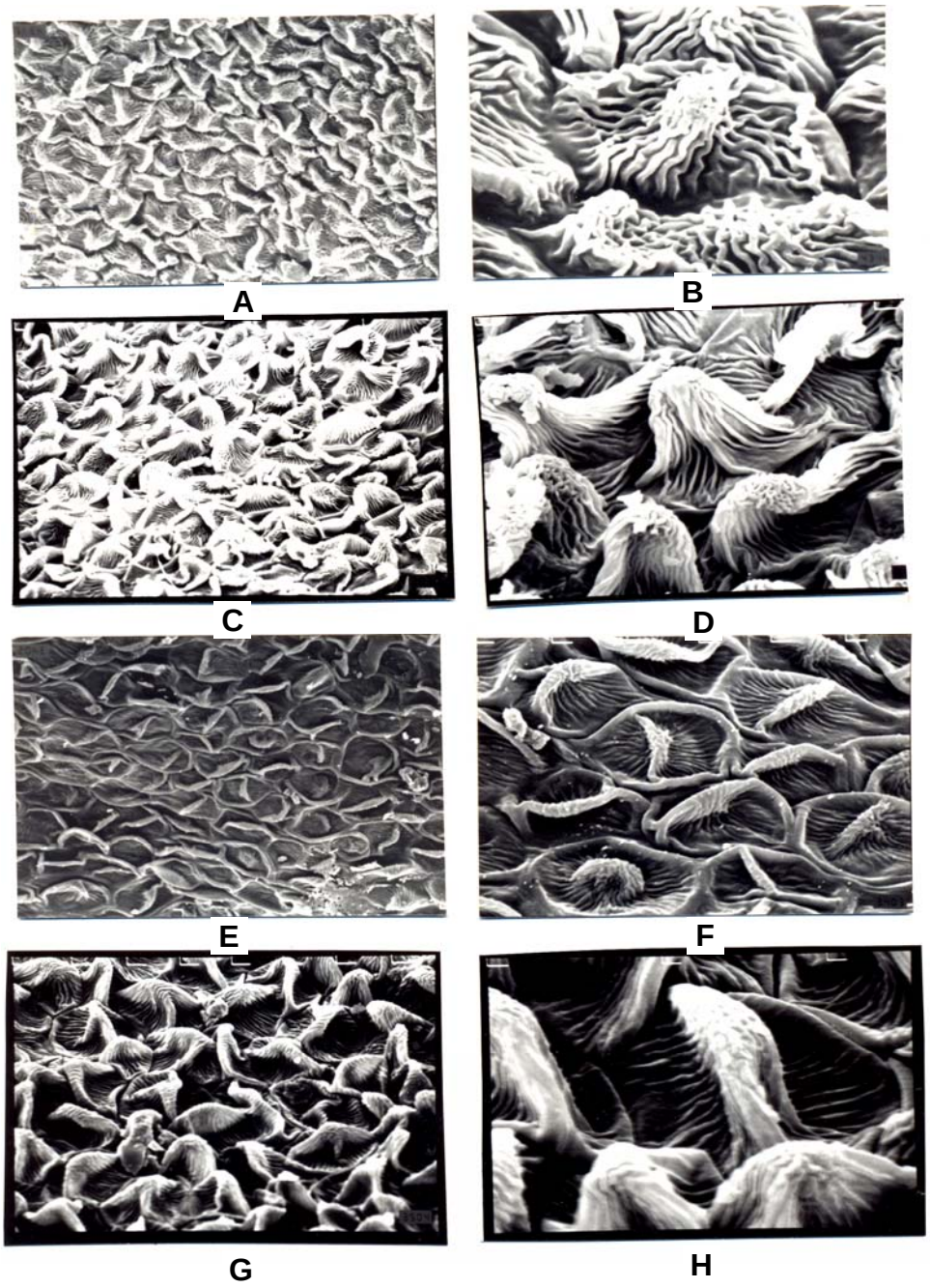

Fig. 1. Scanning Electron Micrographs of petal structure of *Sibbaldia* L. species. A-B, *S. adpressa* Bunge; C-D, *S. micropetala* (Don) Hand-Mezz.; E-F, *S. perpusilloides* (Smith) Hand-Mezz.; G-H *S. purpuea* Royle.

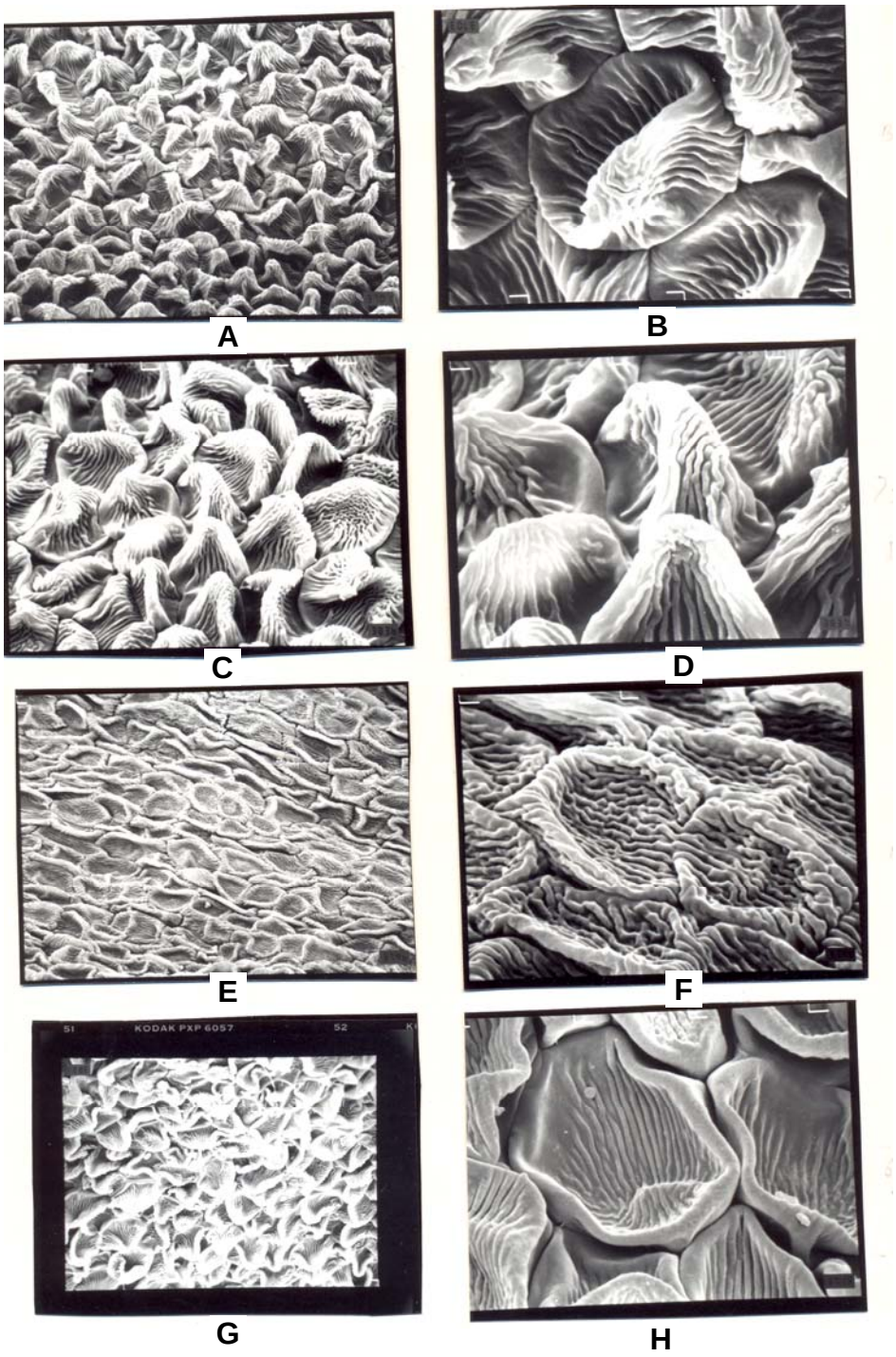

Fig. 2. Scanning Electron Micrographs of *Sibbaldia* species A-B, *S.sikkimensis* (Plain) Chatterjee; C-D *S. unguiculata* Rajput & Tahir; E-F, *S. procumbens* L.; G-H, *S. tetrandra* Bunge.

Appendix-A. List of the Vocher specimen of *Sibbaldia* species used in the S.E.M study of Petal structure.

S. *procumens* L. Rocky alpine meadow at timber line, above China lakes Kereba Basin, S.E. slope. Mt. Emmon. Dunchesne County, Mountains, Northeastren Utah U.S.A. FJ. Hermann 4937, (18) July 1933. (A).
S. *sikkimensis* (Prain) Chatterjee. Eastern - Tibet, Tsanang La. Near Paka. Ludlow, Sherriff & Taylor 5871, 18-7-1938 (A)
S. *micropetala* (Don) Hand- Mazz Shingble Ma La Bhuttan, F. Ludlow, G. Sheriff & J.H. Hicks 20707. (E).
S.tetrandra Bunge. Kara Karam, Charesea glacier Base Camp, 13 miles Eat of Nagar, O. Polunin 6130. 28-71980 (E).
S. *perpusilloides* (Smith) Hand-Mazz. Bhutan, Bumtang, Tolegang Chu, Bowes Lyon 3404, 8-6-1966. (BM).
S. Purpurea Royle. Mountains between the Litang & Yulung Rivers between Muli gamba & Bourong & WaErh-Dje. Rock 16695 July 1928 (US 1334094).
S. *adpressa* Bunge. Sibirica Guv. Irkutsk. Ad. Flumen Lena. Markovstage, H. Nilsson - Ehle 4-6-1898 (K)
S.unguiculata Rajput & Tahir. Lahul District, Cheneb valley Erica Clark sn 2-VIlI-1980 (BM 013168).

S. *tetrandra* Bunge: The petal surface exhibits rugose-tuberculate pattern. The epidermal cells are distinct and loosely packed with thick and smooth walls. The surface between radial walls is striate and irregularly raised into folds and wrinkles or without any prominent folds or wrinkles, in some places giving appearances of a shell-like or boat-like structure (Fig. 2G-H).

Results and Discussion

Heywood (1971) drew attention to the importance and impact of SEM information in the study of systematic problems. The micromorphological data have contributed important information to our understanding of evolution and classification of seed plants and plays significant role in the modern classification of Angiosperms.

The epidermal surface is the functional boundry layer between the living material and its environment and all interaction of environment must pass through this boundary layer. Many workers high lighted the importance of petals has never been done before of leaf, fruit, seed, epidermis and its ornamentation or surface sculpturing in the identification of taxa and determining the relationship, among the taxa viz., Webb *et al*., (1990) Rejdali (1991) Stace (1984) Manning *et al*., (1991) Husain *et al*., (1990). Introduction on macromorphology of petals has been provided is most of the descriptions but perhaps SEM study.

During the SEM study of petals very interesting micromorphological results were obtained in the *Sibbaldia* species, which includes the possible exclusion of one species from this genus invalidity of sections and series recognized by earlier worker.

In all the species of *Sibbaldia*, the corolla consists of 5 free petals except in S. *tetrandra*, which have 4 petals, the base of the petals are mostly narrow, except *S.unguiculata*, in which the base is elongated into an attenuated portion called claw, as in many pink (Caryophyllaceae).

The upper epidermis of petals of all the species of *Sibbaldia* were examined under the S.E.M. Stomata are completely absent in the epidermis of the petals, which demonstrates the non-leaf-like character of the foliar organ. The petal epidermis shows elongated to polygonal cells and with striate to rugose pattern. The anticlinal cell walls are mostly undulate and produce ridge-shaped or striate-shaped processes or folds as a result of growth. According to Kaussmann (1963) these folds or ridges of petal epidermis can be regarded as mechanical strengthening of the cell walls. Wax was not observed on petal surfaces.

The most prominent feature of petal sculpturing observed is usually the shape of cells, particularly the curvature of the outer periclinal wall (Barthlott, 1981). The epidermal cell of petal surface are loosely to closely packed, sometimes the individual cells are not distinct. In some species e.g., *S. adpressa, S. perpusilloides, S. purpurea* and *S. sikkimensis* the epidermal cells are ± circular in outline, but in other species e.g., *S. procumbens* and *S. tetrandra* (Fig. 2 E-F & G-H) the epidermal cells are polygonal to elongated-polygonal in shape.

In *S. unguiculata* (Fig. 2C&D) the epidermal cell appears to be polygonal with raised striations or folds. In *S.micropetala* (Fig. 1 C&D) the curvature of the epidermal cell can not be determined and the central portion of cell is raised into an umbrella-like structure, with epidermal striations or cuticular folds, in *S. micropetala* and *S. unguiculata* (Figs. 1C-D & Fig. 2C-D), petal epidermal cell curvature is convex. Whereas in rest of *Sibbaldia* species petal epidermal cell curvature is flat, with a projection or mini curvature in the centre. In most species of *Sibbaldia* the petal cell shape and surface ornamentation and cell curvatures are sufficiently stable, and can be used as a diagnostic feature.

Macromorphological and micromorphological studies reveals that most of the characters used in the past for the recognization of sections or series are mostly variable, hence feel no justification in recognizing them.

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