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MICROMORPHOLOGICAL STUDIES ON PETALS OF *SPIRAEA* L. SPECIES (ROSACEAE) FROM PAKISTAN

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Abstract

Epidermal micromorphology of petals of 10 species of *Spiraea* L. of the family Rosaceae from Pakistan has been examined with Scanning Electron Microscope (SEM). Micromorphological attributes observed in petals and their reliability as a taxonomic marker is discussed. The epidermal cells exhibit definite geometrical patterns, where cell wall boundaries are more or less elevated and cell surface generally marked with striae. Stomata are completely absent.

Key words: Epidermal micromorphology, SEM, *Spiraea*, Rosaceae.

Introduction

Taxonomically *Spiraea* L., belongs to the family Rosaceae, sub-family Spiraeoidae, tribe Spiraeeae (Hutchinson, 1964). It is represented by 18 species in Pakistan (Stewart, 1972). After reviewing and adjusting the circumscription, only 8 species are recognized in Pakistan (Omer, 2012). The petals and sepals have the same structure as that of the leaf epidermis, parenchyma cells and vascular system (Essau, 1976). All are alike. That's why it is considered that petal is a derivative of leaf.

The patterns and designs on petals are not only to attract the insects but also to guide these pollinators towards the flower. The cali are present at the base of petals that absorb ultraviolet light. The temperature difference makes the petal bases distinguishable easily; where the nectaries are usually present (Thompson, Meinwald, Aneshansley & Eisner, 1972). These patterns differentiate closely related taxa and can be of diagnostic value in taxonomy, (Horovitz, 1972).

During this investigation the micro morphological details of petals of 10 species of *Spiraea* viz., *S. salicifolia, S. zabeliana, S. affinis, S. bella, S. brahuica, S. canescens, S. cantoniensis, S. pilosa, Shypericifolia* and *S. vacciniifolia* have been carried out by Scanning Electron Microscope.

Materials and Methods

The petals were obtained from the flowers of herbarium specimen, belonging to 10 species of *Spiraea.* The material used in this study was obtained from the herbarium sheets borrowed on loan from Royal Botanical Gardens, Kew, England (K); British Museum of Natural History, London (BM); Royal Botanical Gardens, Edinburgh (E); Karachi University Herbarium (KUH); and National herbarium, (Stewart collection) Agricultural Research Council, Islamabad (RAW).

The details of the voucher specimen are provided in appendix. For the SEM studies of the species, complete petals of corolla were taken and mounted onto the stub with double sided adhesive tape from adaxial and abaxial both surfaces on separate stubs. The samples were coated with 30 A gold in a JEOL JSF-1500 Ion sputtering device at centralized research laboratory, University of Karachi and and examined with JEOL JSM-6380 Scanning Electron Microscope, at an accelerating voltage of 5 KV. For this investigation 2-5 samples of petals, from each species were examined and only one voucher has been cited in the appendix. The terminology used to describe the pattern or cell shape is that of Barthlott (1981) and Stearn (1983).

Results:

Micromorphological description of Petal surface:

***S. affinis* Parker:** Petal surface of this species exhibits closely packed adaxially epidermal cells. The cell surfaces are raised into broad finger-like projections or tubercles. The surface as a whole shows striate pattern which is parallel all over the surface except at the tubercle where these intermingled with one another (Fig. 1A).

Abaxial surface of the petal is nearly the same as that of adaxial surface except somewhat thinner walls, striae not so prominent and become flattened at some places; tubercles less elevated and prominent (Fig. 1 B).

***S. bella* Sims:** Petal surface of this species does not show the cell boundaries prominently, the surface striated, Striae arranged either parallel or at right angle, they seem to be elevated or flattened, more or less folded. In the centre of striae plain areas can also be observed easily. Both of the petal surfaces show the same pattern (Fig. 1 C-D**).**

***S. brahuica* Boiss.:** The cells of petal surface of this species boat shaped, margins elevated with ruminate patterns; entire surface striated, striae flowing parallel from margins into the depression in the mid, intermingling with one another. Both surfaces adaxial and abaxial are alike (Fig. 1. E-F).

***S. canescens* D.Don:** The adaxial and abaxial surfaces of this species entirely different. Adaxial surface has loosely packed cells without prominent cell boundaries and more or less thick folds, forming tubercle in the mid of the cell. Striae present all over the surface running parallel to each other, parallel or intermingling at the tubercle. The abaxial surface resemble with that of *S. bella* and does not show the cell boundaries prominently, the surface striated as a whole, parallel or at right angle, elevated or flattened, more or less folded (Fig. 1 G-H).

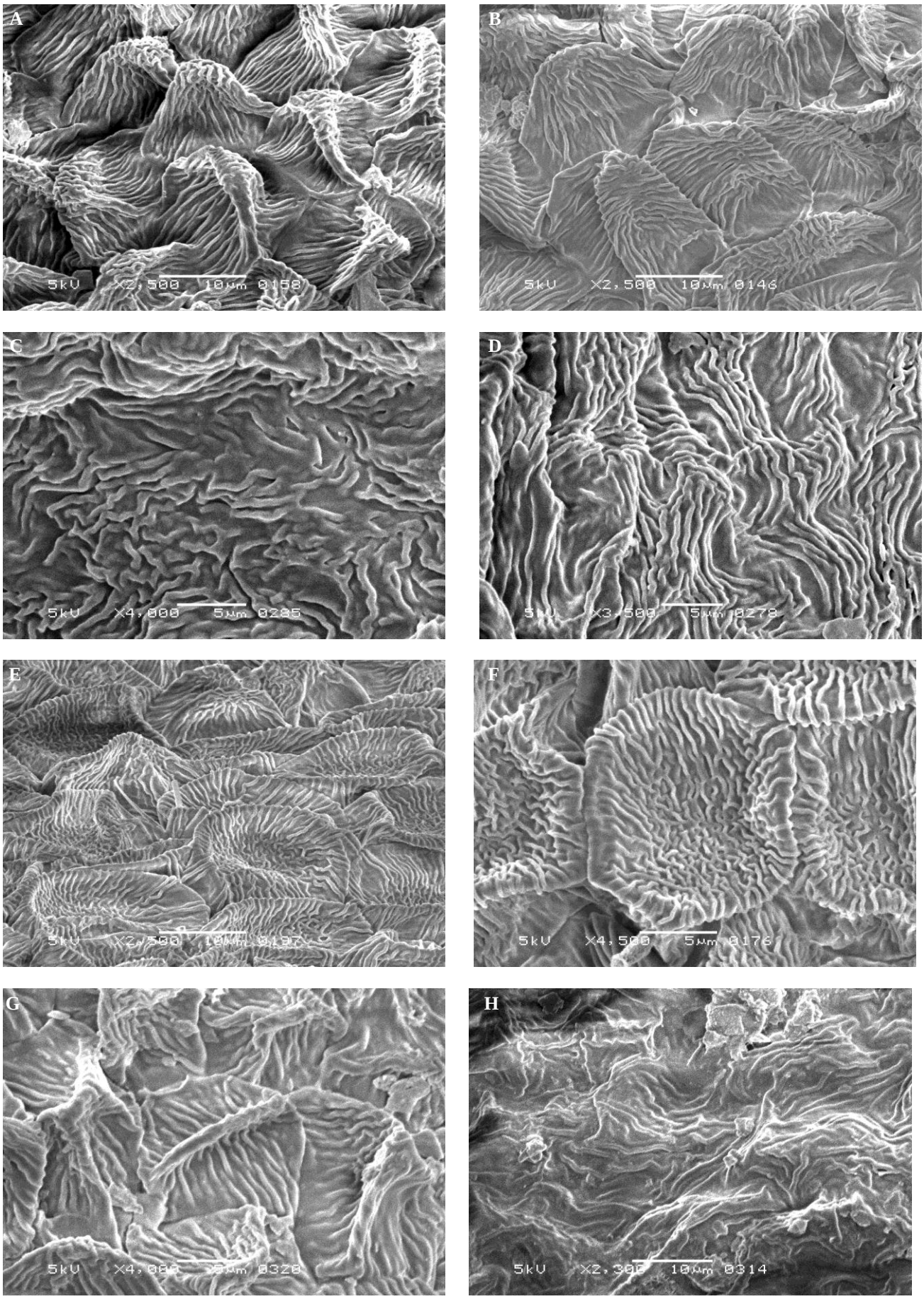

Fig. 1. Petal surface: *S. affinis*, Adaxial surfaces, A & Abaxial surface B; *S. bella*, Adaxial surface C & Abaxial surface D; *S.brahuica*: Adaxial surface E; Abaxial surfaces F; *S. canescens*: Adaxial surfaces, G & Abaxial surface H.

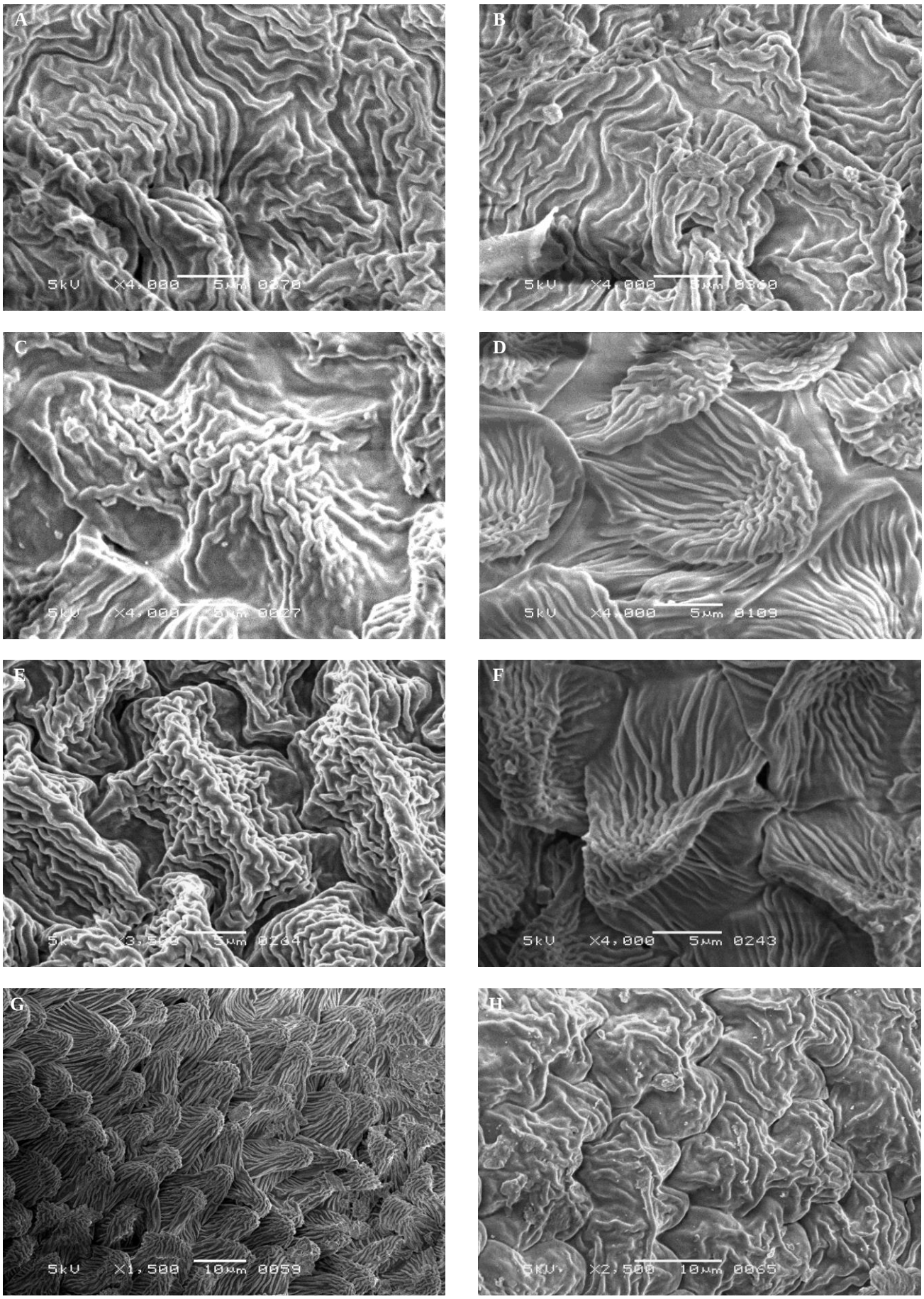

Fig. 2. Petal surface: *S. cantoniensis*, Adaxial surfaces: A; Abaxial surfaces B; *S.hypericifolia*, Adaxial surfaces: C; Abaxial surfaces D; *S. pilosa* adaxial surface: E; Abaxial surface F; *S. vacciniifolia* adaxially: G & Abaxial surface: H.

***S. cantoniensis* Lour.:** Petal surface have a compact layer of cells with uneven cell walls. Less elevated folds, boundary walls not prominent. Entire surface striated with thicker striae as compared to other species. Both surfaces have more or less same structure (Fig. 2 A-B).

***S. hypericifolia* L.:** Petal surface have a compact layer of adaxial cells without prominent cell boundaries, filled with folds and furrows, mound of fold is ruminate becomes parallel striated towards the lower end, depressions plain. Abaxially everything similar except that folds and furrows not so prominent and cell boundaries visible and traceable unlike adaxial surface (Fig. 2 C-D).

***S. pilosa* Franch:** Petal surface of this species loosely packed with traceable cell boundaries. Parallel striations present all over the cells. A tubercle formed in the mid with ruminate patterns. Abaxial surface consists of more loosely packed cells, tubercle mostly Y-shaped (Fig. 2 E-F).

***S. vaccinifolia* D.Don:** Petal surface composed of closely packed cells. Surface of the cell raised into broad finger like projections or tubercle. The surface as a whole striated but at the tubercle becomes ruminate. Abaxial surface quite different from adaxial surface. That consists of closely packed cells; sometimes cell boundaries not traceable. At some places petal surface resembles with that of adaxial surface of *S. pilosa* (Fig. 2 G-H).

***S. salicifolia* L.:** The petal surface composed of compactly arranged cells. Cell boundaries are visible. Surface striated and raised in the mid in the form of a tubercle which has ruminate pattern. Tubercle along with the striations give a worm like appearance or verrucate (Fig. 3 A) Abaxial surface composed of closely packed cells. Cell boundaries are visible. Each cell overlaps the wall of adjacent cell. The surface striated and at somewhere folded.

***S. zabeliana* Schneider:** Petal surface cells closely packed, boat shaped. Boundaries elevated with ruminate pattern and depressions with parallel striations. Abaxial surface of this species devoid of prominent striations, only folds visible (Fig. 3 B).

Discussion

Heywood (1971) drew the attention to the importance and impact of SEM information in the study of systematic problems. The micromorphological studies have opened a door to understand the evolution and classification of seed plants and played a significant role in the modern classification of Angiosperms.

The epidermis is the boundary layer between the outer environment and the plant body. Everything entered or released passes through it. It forms a continuous layer on the surface of the organ. Many workers pointed out the importance of petals, leaf, fruit, seed, epidermis and its ornamentations 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). The upper and lower both epidermis layers may have different surface patterns. Stomates may or may not be present.

All species of *Spiraea*, the corolla consists of five free petals. Petals are mostly orbicular, rounded or broadly oval, narrow or broad obovate .During the study adaxial and abaxial both surfaces of the petals of 10 species of *Spiraea* were examined under the SEM. Stomata are completely absent in the epidermis of petals indicating a non-leafy attribute of foliar appendage. The petal epidermis showed oval or orbicular with irregular walls, impregnated with folds and striations. 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 surface except in *S. cantoniensis*. The attribute was also observed in relation with lower leaf epidermis of the same plant. The most prominent feature of petal sculpturing observed was usually the shape of cells, particularly the curvature of outer periclinal wall (Barthlott, 1981). The cells of epidermal layer were loosely to closely pack; sometimes boundaries were traceable and visible. In some species e.g., *S. affinis* Parker and *S. canescens* D.Don the cells boundaries were circular in outline with raised tubercle in the middle, on the both sides of first species and at the adaxial side of *S. canescens* D.Don. (Fig. 1 G-H); but in *S. brahuica* Boiss., rounded cells were boat shaped with revolute boundaries and a depression in the mid on both surfaces, (Fig. 1 E-F). *S. bella* Sims and abaxial *S. canescens* both don't have prominent boundaries, but still had folds (Fig. 1 C-D; Fig. 1 G-H).

S. cantoniensis Lour., had irregular cell boundaries which were traceable but not easily visible at first glance, (Fig. 3 A-B**)**. *S. hypericifolia* L. had epidermal cells more or less rounded or oval with irregular and prominent out lines and a mound or tubercle with ruminate folds or striae was present in the mid, (Fig. 2 C-D). *S. pilosa* Franch adaxially had the same structure as that of *S. hypericifolia,* (Fig. 2 C-D) but abaxial surface resembles with that of adaxial surface of *S. canescens,* (Fig. 1 G-H**)**.

S. vaccinifolia D.Don had orbicular epidermal cells with raised finger like projections, (Fig.2 G-H). *S. salicifolia* L. had epidermal cells of oval shape at adaxial side with a tubercle in the mid giving a worm like appearance and semicircular at abaxial side, (Fig.3 A).

S. zabeliana Schneider has an adaxial epidermal cells more or less rounded with involute margins and abaxial cells nearly oval with irregular margins and a central tubercle, (Fig. 3 B). This species was mentioned as dubious in "Annotated Catalogue of W. Pakistan & Kashmir". Only one sheet is found in the material under study.

The species of *Spirae* shows resemblance with *Sibbaldia* but shows difference in *S. brahuica* cells which were boat- shaped, while other species have cells with convex curvature and with or without prominent boundaries and sometimes with overlapping boundaries, each layer of cells overlap its adjacent layer (Tahir & Rajput, 2010). In case of *Sibbaldia* all the cells have prominent boundaries without any sort of overlapping of cell layers and there is no example of a mound or tubercle with ruminate folds or striae present in the mid of cell with convex curvature, as in *S. hypericifolia*. Only *Sibbaldia unguiculata* has finger like projections. While in *S. affinis, S. hypericifolia, S. pilosa, S. vacciniifolia, S. cantoniensis, S. salicifolia* and *S. zabeliana,* cell surface either with a convex mound in the mid or with finger like projection. But still visualized the similarities between the two genera very easily both of them belong to the same family, facing same problems of hybridization and out breeding.

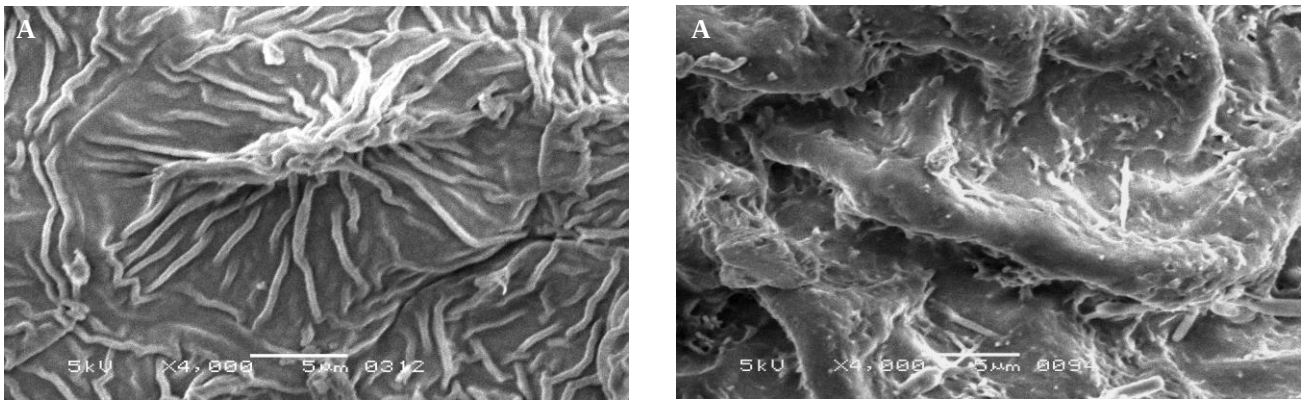

Fig. 3. Petal surface: *S. salicifolia,* Adaxial surface: A; *S. zabeliana,* Adaxial surface: B.

Micromorphological studies on petals of *Spiraea* reveals that the patterns have a great resemblance with one another and show some resemblance with *Sibbaldia* as well. Convex cell surface and concave cell surface can be recognized among the species of *Spiraea* and this character can be used in their identification.

Appendix–A. List of the voucher specimen used in the S.E.M study of Petal structure of *Spiraea* species .

***S. affinis* Parker** Burzil valley, J.F. Duthie, 14004, 11th Sep., 1893, (E 195635).
***S. bella* Sims:** Keran. KishengangaValley, Kashmir, R.R.Stewart, 17590, 14-7-1939, (RAW 27970).
***S. brahuica* Boiss.** ChehlTun. Beloochistan, Stocks, 1867, (KUH 2004/01711 2, 00075648, 000075649).
***S. canescens* D. Don.** Sind Valley, J.F. Duthie, 11428, 23-6-1892, (E 195641).
***S. cantoniensis* Lour.** Hazara Distt. Abbottabad, by Y. Nasir & Rubina Akhtar, 11203, 8-3-1995, (RAW 67443).
***S. hypericifolia* L.** Barper Glacier Karakoram, R. Scott Russel, 1108, 7 1939, (BM) 000834480; Sholar Shun, East of Saroghil Pass (Chitral), J.D.A. Stanton, 3000, 25-07-1958, (E 195652).
***S. pilosa* Franch.** Bashgalian, Kafiristan, S.W of Chitral, J.D. A.Stainton , 19-6-1958 (BM 000834484).
***S. vaccinifolia* D. Don.** Dungagali Cliffs, Stewart, 5351, 30-6-1958, (E 195650).
***S. salicifolia* L.**Pennell Collection, G.A. Burton, Sep., 1886, (RAW 28052). (Locality was not mentioned).
***S. zabeliana* Schneider:** Trankal, Gangbel Lakes, 11,000 ft., R.R. Stewart, 4522, 7-7-1919, (RAW 28011).

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References

Barthlott, W. 1981. Epidermal and seed surface characters of plants: Systematic applicability and some evolutionary aspects. *Nord. 1. Bot.*, 1: 345-355.

Essau, K. 1965. *Plant Anatomy*. John Wiley & Sons, New York.

Heywood, V.H. 1971. *Scanning Electron Microscopy*. Academic Press, London.

Horovitz. 1972. Ultraviolet Reflectance Characteristics in Flowers of Crucifers. *Am. J. Bot*., 59(7): 706-713.

Husain, S.Z., P.D. Marin, Č. Šilic, M. Qaiser and B. Petcovic. 1990. A micromorphological study of some representative genera in the tribe Saturejeae (Lamiaceae). *Bot. J. Linn. Soc.*, (103): 1.

Hutchinson, J. 1964. *Genera of Flowering Plants*. Vol.1, p.182, Clarendron Press, Oxford.

Kaussmann, B. 1963. Pflanzenanatomic., unter besonderer Berucksichtigung der Kultur. Und Nutzpflanzen. Gustav Fischer, Jena.

Manning, J.C. and P. Goldblatt. 1991. Systematic and Phylogenetic sig. of the seed coat in the shrubby African Iridaceae. Nivenia, Klattia and Witsenia. *Bot. J. Linn. Soc*., 107: 387-404.

Omer, S.A. 2012. *Taxonomic Study of Spiraea in Pakistan*, M.Phil. thesis, Institute of Plant Sciences, University of Sindh, Jamshoro, Pakistan.

Rejdali, M. 1991. Leaf Micromorphology and Taxonomy of North African Species of *Sideritis* L. (Lamiaceae). *Bot. J. Linn. Soc*., 107: 67-77.

Stace, C. 1984. The Taxonomic importance of the leaf surface in V.H. Heywood & D.M. Moore (Eds.). *Curr. Con. Pl. Tax*., 60-94. London Academic Press.

Stearn, W. 1983. *Bot. Lat.* 3rd Ed. Rev. David & Charles, Newton Abbott. London.

Stewart, R.R. 1972. In: Ali & Nasir, (Eds) *An annotated catalogue of vascular plants of W. Pakistan and Kashmir*, 769, Karachi: Fakhri print. Press.

Tahir, S.S. and M.T. Rajput. 2010. SEM studies of petal structure of corolla of the species *Sibbaldia* L. (Rosaceae). *Pak. J. Bot*., 42(3): 1443-1449.

Thompson, Meinwald, Aneshansley and Eisner. 1972. *Flavonoid pigments responsible for ultra violet absorption in nector guide of flower sciences*; 11; 177(4048): 528-30.

Webb *et al*. 1990. Micromorphology of the leaf epidermis in taxa of the *Agropyron- Elymus* complex (Poaceae). *Bot. J. Linn. Soc.*, (103)2: pp. 153-158.

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