

S.E.M. STRUCTURE DISTRIBUTION AND TAXONOMIC SIGNIFICANCE OF FOLIAR STOMATA IN *SIBBALDIA* L. SPECIES (*ROSACEAE*)

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Abstract

The S.E.M. structure, distribution and taxonomic significance of foliar stomata in the species of the genus *Sibbaldia* L. (Rosaceae) has been examined with Scanning Electron Microscope. Stomata are mostly anomocytic type, usually present on both surface of the leaves. Differences in shape, size, distribution and the orientation of stomata have been observed. Except in 2 species, subsiding cells are mostly covered with non-oriental wax. Both elevated and sunken stomata with elongated to circular stomatal apparatus are found.

Introduction

Linnaeus (1753) named the genus *Sibbaldia* after Robert Sibbald (1643-1720) an Edingburgh naturalist and Physician. Seringe (1825) followed Linnaeus and recognized *Sibbaldia* L., and *Potentilla* L., as distinct genera and included them into the tribe Dryedeae Vant. Hooker (1878) reduced *Sibbaldia* as a section of the genus *Potentilla* L. Again Focke (1888) treated the *Potentilla* L., and *Sibbaldia* L., as distinct genera. Muravjava (1936) recognized three sections within the genus *Sibbaldia* mainly on the number of leaflets in the leaves. Juzepczuk (1941) described *Sibbaldianthe* Juz., a new genus based on *Sibbaldia adpress* Bunge but Hutchinson (1964), Sojak (1970), Airy Shaw (1973) and Dixit & Panigrahi (1981) placed the *Sibbaldianthe* Juz., under synonym of *Sibbaldia* L. Last taxonomic treatment of *Sibbaldia* species was reported by Rajput *et al.*, (1997) in which they recognized 10 species. Majority of the species are distributed in South East Asia, except *S. procumbens* which is also found in Europe and North America. The literature survey indicates that so far no study of the foliar stomata has been carried out on *Sibbaldia* species.

Materials and Methods

For this study the mature leaf samples were obtained from the herbarium material. In *Sibbaldia* species leaves are mostly compound. In most cases, a medium sized leaflet was used, in case the leaflets were big, small portion of 5-6 sq mm from the center was taken for SEM. study, both upper and lower surfaces of the leaves were examined.

The samples were fixed onto the stubs with double sided adhesive tape. The samples were coated with 30° gold in a palavon sputter coater and were examined with Jeol JSM-T20 Scanning Electron Microscope, at an accelerating voltage of 20 KV, at the Reading University U.K. For each species 3-4 samples of the leaflets were examined, only one voucher is cited in the appendix. The terminology used in this paper follows Metcalf & Chalk (1950), Cotthem (1970) and Rasmussen (1981).

Results and Discussion

Observations

***S. adpressa* Bunge:** The epidermis of the leaf is covered with waxy substance. A few anomocytic stomata are found on the lower surface which are deeply sunken in non-oriented wax (Fig. 1 A&B) Stomatal apertures are circular.

***S. micropetala* (D.Don) Hand–Mazz:** The upper epidermis of leaf has anomocytic stomata which are prominently raised above the epidermal surface (Fig. 1 C&D). The subsidiary cells are flat, with concentric rings of 1 to 2 striate surrounding each stomata. Stomata apertures are broadly elliptical, the lower leaf surface has thick density of trichomes, which are soft, snow white and interlaced. The detailed study of stomata was not possible due to high density of trichomes.

***S. purpussilloides* (Smith) Hand–Mazz:** The upper leaf surface has irregular cell arrangement. Anomocytic stomata are quite abundant with wide stomatal apertures and narrow rim with expanded ends stomata are present at the same level of epidermal cells i.e. neither elevated nor sunken. In this species wax is completely absent (Fig. 1 E&F).

***S. purpurea* Royle:** On the upper surface, the epidermal cells are closely packed, exhibiting irregular colliculate pattern. Stomata are anomocytic, densely distributed, mostly sunken in the epidermal cells. Stomata are surrounded by wax, which forms more or less net-like structure (Fig. 2 A&B)

***S. sikkimensis* (Prain) Chatterjee:** The upper surface of the leaf is densely covered with snow white wax giving spongy appearance. A very few anomocytic type of stomata more or less sunken are found on upper surface (Fig. 2 C&D). Stomata are not seen on the lower surface of the leaves.

***S. tenuis* Hand-Mazz:** The upper leaf surface shows a verrucate pattern with irregular cells arrangement. Anomocytic type of stomata are present on both the surfaces, which are deeply sunken. Neighbouring cells shows striate pattern with narrow stomatal apertures. (Fig. 2; E&F).

Appendix–A. List of the voucher specimen of *Sibbaldia* species used in the foliar stomata study.

- **S. adpressa* Bunge. Nertschinsk, J. Frevn 12 (BM)
 - **S. micropetala* (D.Don) Hand-Mazz. Kashmir, Srinagar, above Gulmerg, Khillanmerg, plateau, Lancaster 2(BM)
 - **S. purpurea* Royle China, Szechuan, west slopes of Mt Mitzuga, Muli Territory, Rock 24038 (A)
 - **S. purpussilloides* (Smith) Hand – Mezz. Himalyas chakung chu sikkiu, Cooper 930 (E)
 - **S. Sikkimensis* (Prain) Chatterjee. Mount Fu-chuan, S.W. of i –Hsi Mekong – Salwin divide, Rock 16987 (A)
 - **S. Tenuis* Hand-Mazz. China, Sichuan province, Donrergo in Proto, alpino , 4300 – 4400 m, 20 July 1922, Harry Smith 3806 (A)
 - **S. tetrandra* Bunge. Afghanistan, 55.6 miles of Herat Road to Khandahar, Grey Wilson & Hewer 533 (E)
 - **S. unguiculata* Rajput & Tahir. Lahul district, chenab Valley, 13000 ft, Erica Clerk s.n. 2-VIII – 1980 (BM)
 - **S. procumbes* L. Gangalwat Gol, Kafristan, S.W. of Chitral, Stainton 2722 (A)
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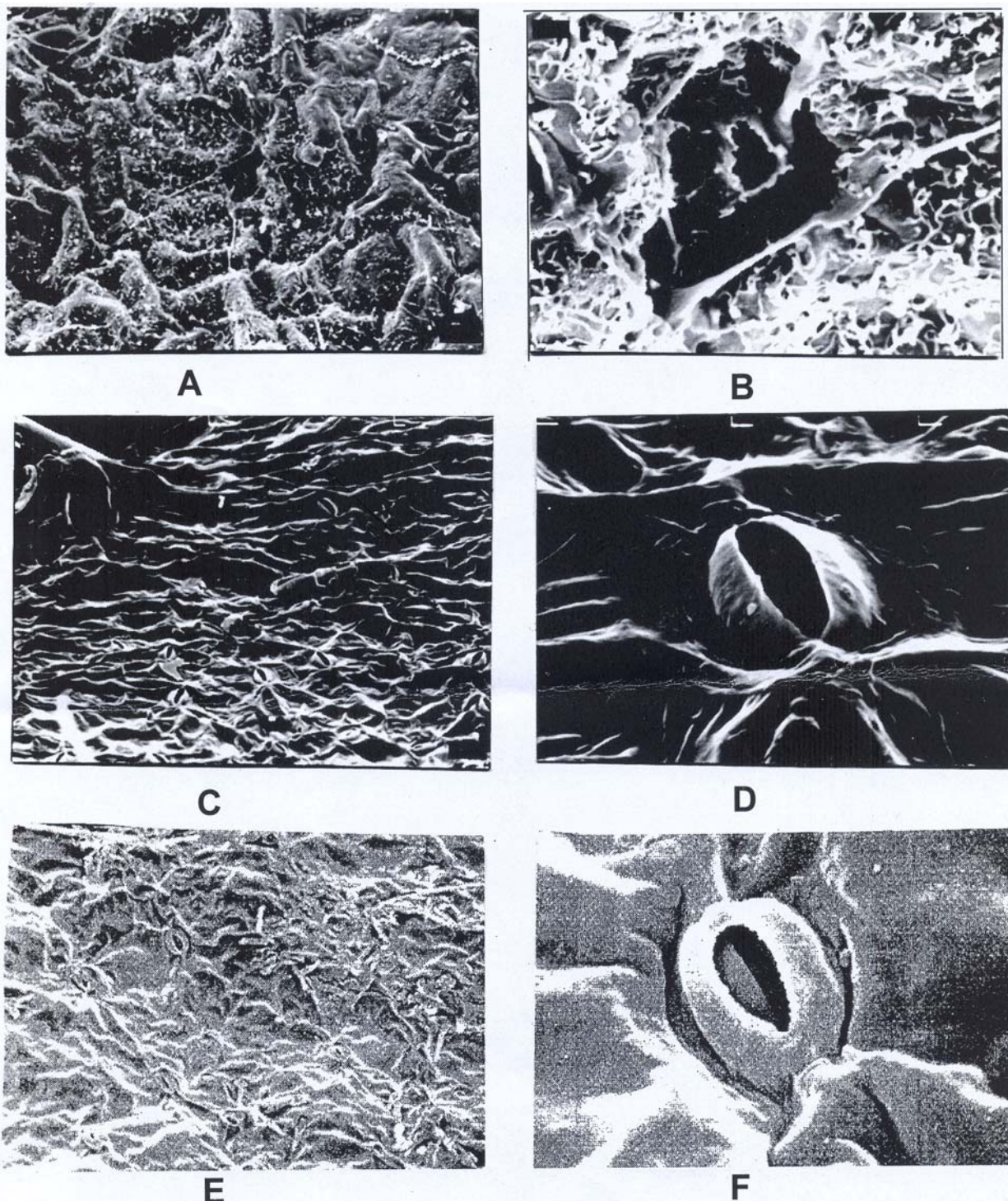


Fig. 1. Scanning Electron micrographs showing foliar Stomates.

A-B, *S. adpressa* Bunge; C-D, *S. micropetala* (D. Don). Hand- Mazz; E-F, *S. purpusilloides* (Smith) Hand- Mazz

***S. tetrandra* Bunge.:** The epidermis of the upper leaf surface show irregular arrangement, exhibiting low verrucate pattern (Fig. 2 A&B). Stomata are anomocytic type, which are sparsely distributed and deeply sunken, present on both surface of leaves.

***S. unguiculata* Rajput & Tahir:** The upper leaf surface shows verrucate epidermal pattern, which is covered with waxy substance. The cells are somewhat irregularly arranged. Stomata are anomocytic and densely distributed on the both leaf surfaces. Stomata are mostly raised on the epidermal cells with narrow stomatal apertures (Fig. 3 C&D).

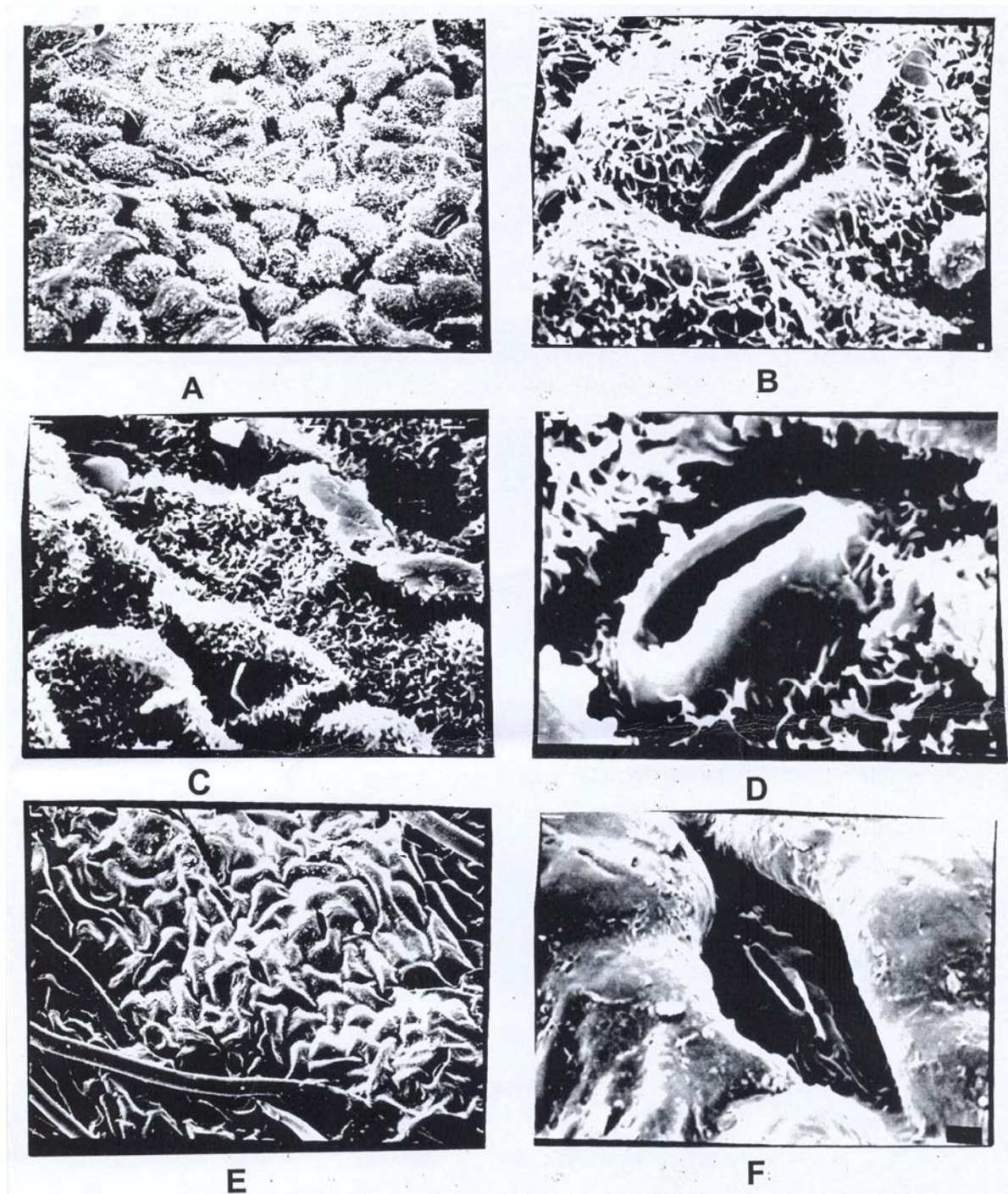


Fig. 2. Scanning Electron micrographs showing foliar Stomates.

A-B, *S. purpurea* Royle; C-D *S. sikkimensis* (Prain) Chatterjee; E-F, *S. tenuis* Hand-Mazz.

***S. procumbens* L.:** The upper leaf surface shows verrucate epidermal pattern, which is densely covered with non-oriented wax. Stomata are anomocytic with narrow to broad elliptical aperture; densely distributed on the both surfaces. Stomata are mostly sunken (Fig. 3 E&F).

Stomata are very important small openings found in epidermis of green aerial parts, especially leaves of the plants. Usually present on the both surfaces of the leaves. They helped in performing physiological functions like photosynthesis, respiration and transpiration. In recent past probably more work has been carried out on stomatal structure and development, and on their use in assessing taxonomic relationships and evolutionary pathways, than any other leaf character. (Wilkinson, 1979).

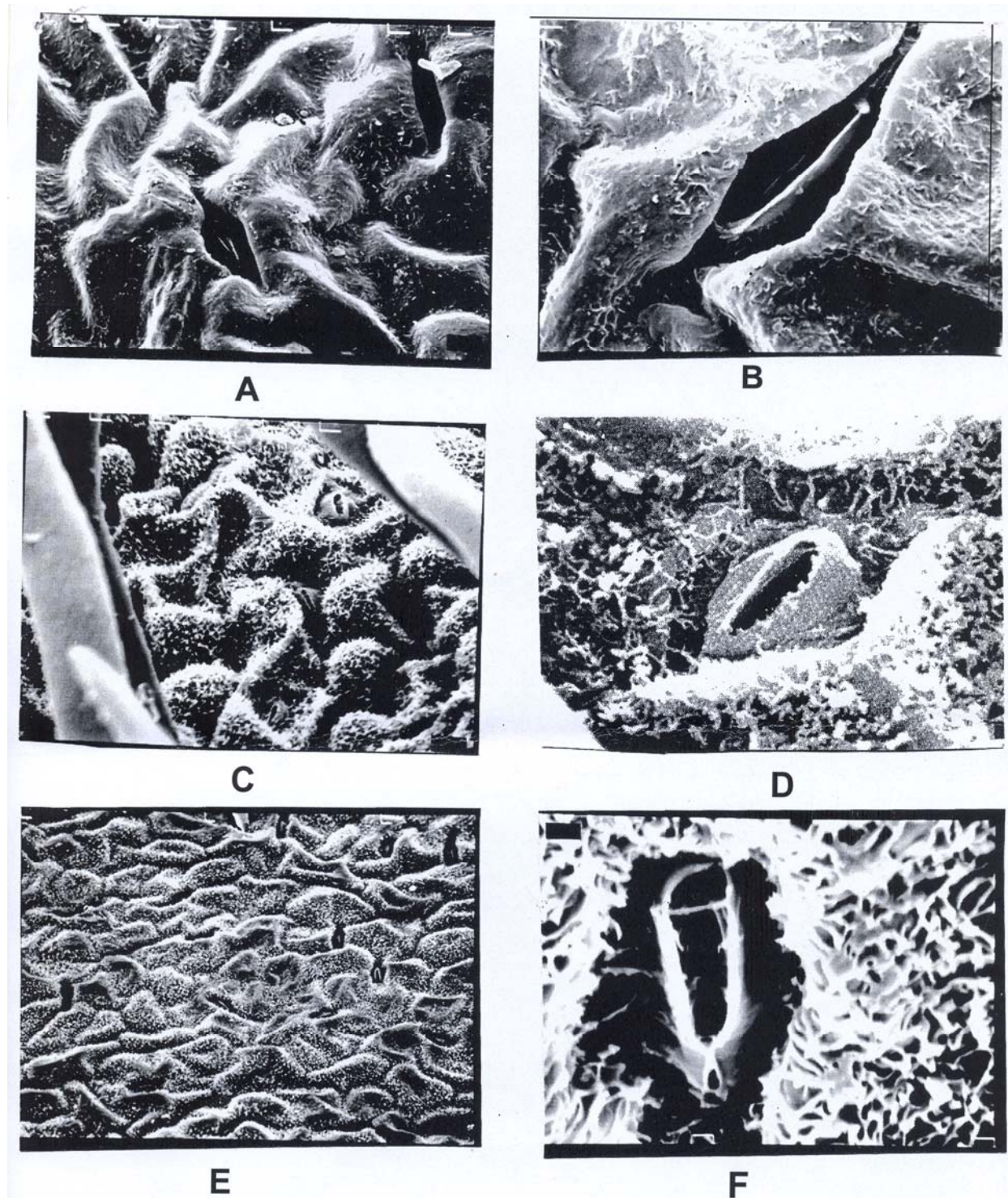


Fig. 3. Scanning Electron Micrographs showing foliar Stomates.
A-B, *S. tetrandra* Bunge; C-D, *S. unguiculata* Rajput & Tahir; E-F, *S. procumbens* L.

The shape, size distribution and the orientation of the stomata and the various thickenings and ornamentation of the guard cells are all characters, which are frequently used in taxonomic work. Stomata are usually anomocytic, occurring mostly on both surfaces of the leaves, with variable frequency and degree of elevation and sunkenness. In *S. procumbens*, *S. adpressa* and *S. purpurea*, the stomata are covered with heavy deposition of wax; which usually obscures the subsidiary or neighbouring cells. In some species of *Sibbaldia*, stomata are only found on the upper leaf surface. Due to the high density of trichomes on the lower surface of the leaf, the detailed study of the stomata is not possible.

In *S. micropeteta* the frequency of stomata is very high, as compared to other species of *Sibbaldia*. In this species the stomata are superficial or raised, above the epidermal surface, with flat neighbouring cell, showing few circulate striate ridges, the guard cells are fairly thick. Wax is completely absent on both the surface.

In *S. perpussilloides* the stomata are slightly sunken, with elevated guard cells. The guard cells are thick walled with expanded ends. The guard cells and the neighbouring cells are covered with wax.

In *S. tetrandra* the stomata are deeply sunken in folded epidermal cells and have long apertures. The neighbouring and guard cells have no prominent wax.

In *Sibbaldia* species stomata occupy three different positions with regards to the epidermal cells.

- a. Stomata found at the same level of epidermis e.g., *S. purpussilloids*.
- b. Stomata sunken, found in depression on epidermis e.g., *S. tetrandra*.
- c. Stomata are raised above the surface of epidermis e.g., *S. micropetala*.

Rasmussen, (1981), Payne (1979), Cotthem (1970), Metcalf & Chalk (1950) have classified the stomata into different types on the basis of structure and shape of neighbouring epidermal or subsidiary cells. By using Metcalf & Chalk (1950) concept, the stomata of the *Sibbaldia* are classified as Anomocytic type. It is also called irregular-celled type of stomata. In this type the subsidiary cells are indistinguishable from other epidermal cells. Such cases are also reported in the members of family Ranunculaceae, Papaveraceae, Capparidaceae and Nyctaginaceae.

The level of elevation and sunkenness of the stomata on the leaf epidermis, presence and absence of wax, on the guard cells and the neighbouring cells, provide an important taxonomic tool for the identification of *Sibbaldia* species.

Acknowledgements

We are grateful to Dr. S.Z. Hussain of Fatima Jinnah Women University Rawalpindi and Dr. Muhammad Qaiser, Federal Urdu University of Science and Technology Karachi for constructive comments on the manuscript. We wish to express our sincere thanks to Dr. S. Jury of Reading University U.K, for borrowing herbarium specimens from different herbaria. We are also grateful to Dr. Lynda Bonner and Miss. Jackie Connolly for technical assistance. Access to collections was generously provided by BM, K, A and E, which is gratefully acknowledged.

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(Received for publication 17 September 2008)