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POLLEN MORPHOLOGY OF *SIBBALDIA* SPECIES (ROSACEAE)

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Abstract

The pollen grain of all the species of the genus *Sibbaldia (*Rosaceae*)* has been examined by light microscope (LM) and Scanning Electron Microscope (SEM). The pollen grains are prolate spheroidal to prolate. Colpi are long and thin. On the basis of size, the pollen grains are divided into two groups.

Introduction

Linnaeus (1737) named the genus Sibbaldia after an Edinburgh University botanist Robert Sibbald (1643-1720). Taxonomically the genus Sibbaldia belongs to the Tribe Potentillae of family Rosaceae and sub-family Rosoideae, (Hutchinsin, 1964). This taxa was systematically reviewed by different workers at different time in different parts of the world, which includes Seringe (1825), Endlicher (1840), Bunge (1829), Hooker (1878), Focke (1888), Murvjova (1936), Chatterjee (1938), Juzepzuk (1941), Hutchinson (1964), Airy Shaw (1973), Sojak (1970) and Dixit & Panigrahi (1981). Rajput *et al*., (1997) while reviewing this genus at the global level recognized 10 species.

The species of this genus are distributed in Asia, Europe, and North America, but majority of them occur in south East Asia. *Sibbaldia* species are mostly tomentose or glabrescent perennial small erect or cushion like herb with short caespitose from a prostrate woody roots. The branches at the base are mostly clothed with stipule. The closely related genera are P*otentilla* L., *Horkelia* cham Schlechtd and *Chamaerhodos* Bunge.

Sojak (1970) recognized three sections; Juzepezuk (1941) established two series and Dixit & Panigrahi (1981) recognized seven sections within *Sibbaldia*. Rajput *et al*., (1997) while reviewing this genus at the world level and the detailed examination of all the types rejected all the series and sections recognized by the previous workers. The literature survey indicates that the pollen morphology of *Sibbaldia* has not been carried out. The present paper reports the palynological detail of all the species of *Sibbaldia*. The vast majority of the taxa examined in *Sibbaldia* had very similar pollen.

Material and Methods

The pollen samples were obtained from the herbarium specimen, which were borrowed on loan by Professor Tahir Rajput from the following herbaria: A, BM, E, K and US.

For the light microscopic study of pollen grain, classical acetolysis method of Erdtman (1966) was followed. For SEM study Pollen were sputter–coated with gold palladium and examined and photographed with the Scanning Electron Microscope at the Plant Science Laboratories at the Reading University U.K. In case when a species have distribution in different continents, then specimens from each continent of that species were examined in order to account the whole range of variations in pollen characters. Voucher specimen for pollen illustrated in this contribution is listed in Table 1.

Table 1. List of the voucher specimens used in Palynological investigations

S. adpressa:	USSR, Sibiria Guv. Irkutsk. Nelson Ehle. S.N., 4-6-1898 (A).
S. micropetala:	Bhuttan, Shingbe Me La N.E. of Bhuttan, F. Ludlow, G. Sherriff & J.H. Hicks 20707 (A).
S. pupurea:	Mountains between Titang and yulung Rivers, rock 16695, July 1928, (US 1334094).
S. purpusilloides:	Bhuttan, Bumgland Telegang Chie Bowea Lyon 3404, 8-6-1966 (BM).
S. sikkimensis:	Wei-His Mt. China Me. Laren 69, 5-4-1933 (E).
S. tetrandra:	China Tibet Penla: Kingdim Ward 11700 (BM).
S.trullifolia:	Sikkim J.D. Hooker s.n. (K).

The terminology used for pollen description is in accordance with Erdtman (1952) Faegri & Inverson (1975) and Kremp (1965).

General pollen characters of genus *Sibbaldia* L.

Pollen class: 3– colporate. P/E ratio (pollen shape): Prolate spheroidal–euprolate. Size: small medium. Apertures: Colporate, colpi long, narrow, constricted at equator. Pori circular with very faint appearance. Exine as thick as nexine or thicker than nexine. Measurements: Polar axis 16-38 μm. Equatorial diameter 12-24 μm. P/E ratio 1.01 – 1.4. Exine ca 1.2-2.0 μm. Colpus length ca 10-23 μm, colpus breadth 2-6 μm. Mesocolpia 7-16 μm. Tectum striate in all species. Tectum striate in all the species.

Pollen description and taxonomic remarks: The pollen grains of all species of *Sibbaldia* was examined with light microscope and Scanning Electron Microscope. A complete description of pollen with illustrations are provided along with brief remarks which indicates its relationship with other species, important features and distributions.

***Sibbaldia adpressa* Bunge (Fig. 1H)**

Pollen grains subprolate in shape, AMB circular, circulaperturate, Isopolar, radio symmetric, Size, small to medium. Pollen length of ca. 24.0-28.0μm. Pollen breadth ca. 19.0-22.0 μm, Tricolporate (Colpi constricted at the equator), Colpus length ca. 16.0-22.0μm, Colpus breadth ca. 2.0-4.0μm. Proicircular. Size ca. 2.0μm in diameter. Mesocolpium ca. 10.0-12.0μm. Exine ca. 1.8 μm. Sexine tectate, ca. 1.0 μm in the center of mesocoplium gradually thinner, towards the apertures. Nexine ca. 0.8μm, nexine thinner than sexine.

Taxonomic remarks: Pollen grains size small to medium. In this respect they show some relation to *S. procumbens* and *S. trulifolia*. Sexine is almost equal to nexine and this character is similar to grains of *S. micropetala, S. procumbens, S. sikkimensis* and *S. trullifolia*. However, in case of *S. micropetala* the sexine of the grains is smaller than *S. adressa*. This species is distributed in China, Nepal and U.S.S.R.

***Sibbaldia micropetala* (D.Don) Handel-Muzzetti (Fig. 1 D)**

Pollen description: Pollen grains prolate-spheroidal in shape. AMB circular, Isopolar, radiosymmetric. Size small, pollen length ca. 18.0-20.0μm, Pollen breadth ca. 11.0-13.0μm, Colpus breadth ca. 4.0-5.0 μm, poricircular. Pore size ca. 2.0-3.0μm. Sexine tectale, ca. 1.0 μm almost equal in size to sexine. Tectum striate.

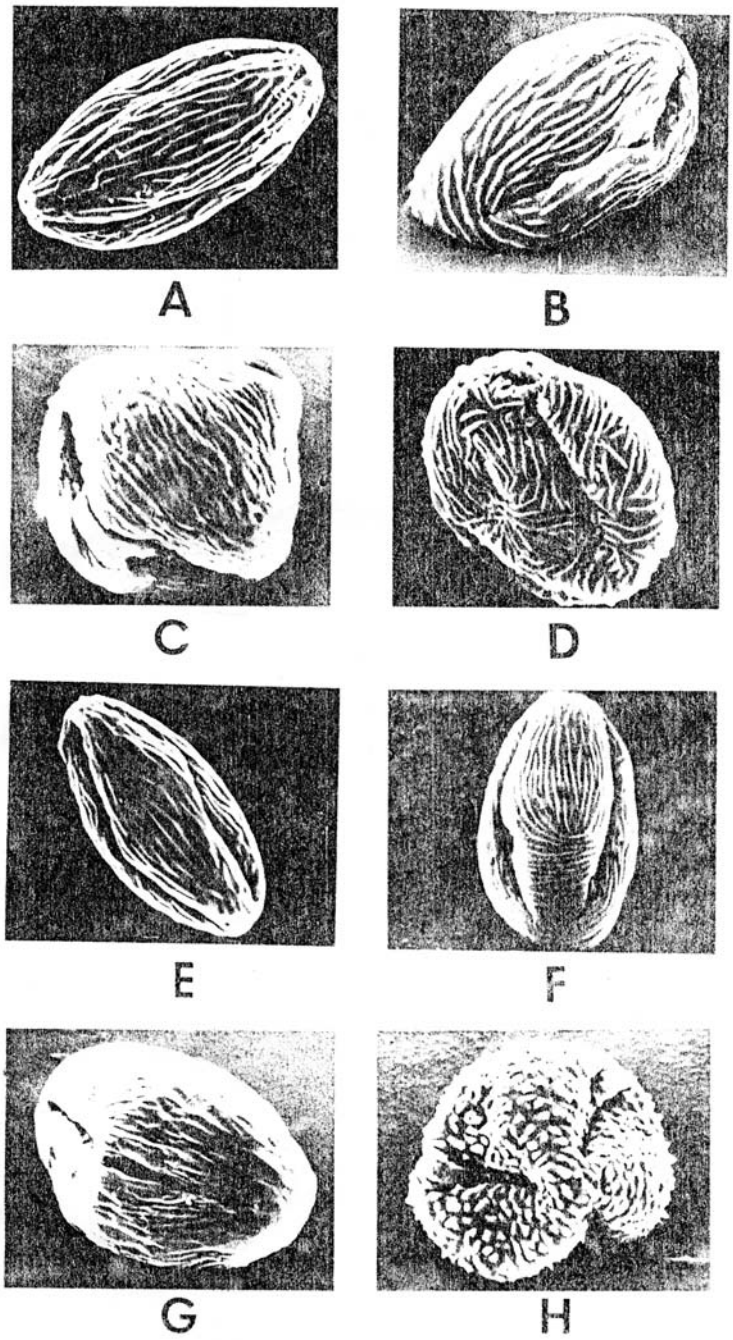

Fig. 1. Pollen grains of *Sibbaldia* species, showing general morphology:
A= *S. procumbens* 1700X; B= *S. trulliflolia* 2000X; C= *S. purpurea* 1700X; D= *S. micropetala* 2400X; E= *S. purpusilloides* 2500X; F= *S. tetrendra* 1650X; G= *S. sikkimensis* 2100X; H= *S. adpressa* 1350 X.

Taxonomic remarks: Grains size is rather small and generally less than 20 μm. In this respect it is similar to *S. sikkimensis*. In size the grains of *S.micropetala* are more closely related to S.purpusilloides but in the later the sexine is thicker than nexine. In *S.micropetala* sexine thickness is almost equal to nexine and in this respect it is more closely related to *S.sikkimensis*. This species is distributed in Bhuttan, India, Nepal, Sikkim, eastern Himalaya and Yunnan province of China.

***Sibbaldia procumbens* L. (Fig. 1 A)**

Pollen description: Pollen grains prolate spheroidal sub–prolate. AMB circular, Isopolar, radiosymmetric. Size small medium, Pollen length ca. 21.0-38.0 μm Pollen breadth ca.17.0-24.0 μm. Tricolporate (Colpi contricted at equator), Colpus length ca. 13.0-23.0μm, Colpus breadth ca. 3.0 – 6.0 μm, or a circular pore size ca. 4.0-5.0 μm in diameter. Mesocolium ca. 12.0-14.0μm.

Exine ca. 2.0 μm. Sexine tectate ca. 1.0μm thick in center of mesocolpium gradually thinner towards the apertures. Nexine ca. 1.0μm. Nexine almost equal to sexine in thickness.

Taxonomic remarks: Size small to medium. This character has close resemblance with *S. adpressa* and *S. trullifolia*. It is noteworthy that specimens which have been collected from Turkey, the pollen grains are all of medium size and euprolate in shape. This character differs from grains of the same species collected from other localities. Sexine is almost equal in thickness to nexine. This character is also similar to *S. adpressa* and *S. trullifolia*. This species is found in Asia, Europe and North America, Rajput *et al*., (1997).

***Sibbaldia purpurea* Royle (Fig. 1C)**

Pollen description: Pollen grains sub-prolate in shape, circular in outline, isopolar, radio symmetric. Size small, pollen length ca. 18.0-24.0 μm. Pollen breadth 12.0-20.0 μm. Tricolporate, colpus ca. 12.0-16.0 μm. Colpus breadth ca. 2.0-4.0 μm, poricircular, pore size ca. 3.0 μm in diameter. Mesocolpium ca. 7.0-15.0 μm; exine ca. 1.2 μm. Sexine tectate ca. 0.8 μm thick in the center of mesocolpium, generally thinner towards the apertures. Nexine ca. 0.4 μm, thinner than sexine.

Taxonomic remarks: The pollen grains size is small and in this respect it is similar to *S.micropetala, S.sikkimensis, S.purpusilloides* and *S. tetrandra.*

The sexine is almost twice in thickness than nexine and this character has resemblance with *S. purpusilloides* and *S.tetrandra*. This species is occurring in Nepal and South Western China.

***Sibbaldia purpusilloides* (W.W.Smith) Handel-Mazzetti (Fig. 1E)**

Pollen description: Pollen grains Prolate-spheroidal in shape, AMB circular, Isopolar, radiosymmetric. Size small, Pollen length ca. 16.0-19.0 μm, pollen breadth ca. 14.0-18.0 μm, Tricolporate (Colpi constricted at equator), Colpus length ca. 10.0-12.0 μm. Colpus breadth ca. 3.0-4.0 μm. Pori circular; pore size ca. 3.0 μm in diameter. Mesocolpium ca.

11.0-12.0 μm. Exine ca. 1.3μm. Sexine tectate ca. 0.9 μm thick in center of mesocolpium, becoming gradually thinner towards the apertures. Nexine ca. 0.4 μm. Nexine thinner than sexine.

Taxonomic remarks: Pollen grains smaller than all the other species and show similarity with, *S. micropetala*, *S. purpurea*, *S. sikkimensis* and *S. tetrandra*. Sexine almost twice in thickness than nexine. This character closely resembles with S. *purpurea* and *S.tetrandra*. This species have distribution in Afghanistan, Burman, Bhuttan, Nepal and China.

***Sibbaldia sikkimensis* (Prain) Chatterjee (Fig. 1.G)**

Pollen description: Pollen grains prolate spheroidal in shape. AMB circular, isopolar, radiosymmetric, size small. Pollen length ca. 18.0-21μm. Pollen breadth ca. 16.0-18.0 μm; tricolporate (Copli constricted at equator). Colpus length ca. 12.0-14.0 μm. Colpus breadth ca. 3.0-4.0 μm. Pori circular, Pore size ca. 3.0 μm in diameter; mesocolpium ca. 11.0-12.0 μm.

Exine ca. 1.7-2.0 μm. Sexine tectate, ca. 1.0 μm thick in center of mesocolpium, gradually thinner towards the apertures. Nexine ca. 0.9 μm, nexine almost equal in thickness to sexine.

Taxonomic remarks: Grains small, the species has similarity with *S. micropetala* and *S. purpusilloides*. However sexine in *S. sikkimensis* is almost equal to nexine in thickness. Due to this character it has close resemblance with *S. micropetala*. Distributed on China, upper Burma and Nepal.

***Sibbaladia tetrandra* Bunge. (Fig 1:1)**

Pollen description: Pollen grains prolate-spheroidal to sub-prolate. AMB circular, Isopolar, radiosymmetric. Size small, Pollen length ca. 19.0-24.0 μm; Pollen breadth ca. 16.0-014.0 μm. Tricolporate (Colpi constricted at equator). Colpus length ca. 12.0-14.0 μm. Colpus breadth ca. 3.0-5.0 μm. Pori circular, pore size ca. 3.0 μm in diameter. Mesocolpium ca. 10.0-16.0 μm. Exine ca. 1.2 μm. Sexine tectate, ca. 0.8 μm thick on centre of mesocolpium gradually thinner towards the apertures. Nexine ca. 0.4 μm, almost equal in thickness to Sexine.

Taxonomic remarks: Pollen grains are of small size. They resemble with *S. micropetala*, *S. sikkimensis*, *S. purpusilloides*. Sexine is almost twice in thickness then nexine and due to this character it is more closely related to *S. purpurea* and *S. purpusilloides*. This species is distributed in China and Pakistan

***Sibbaldia trullifolia* (Hooker F.) Chatterjee (Fig. 1B).**

Pollen description: Pollen grains prolate-spheroidal in shape. AMB circular, isopolar, radiosymmetric. Size small, pollen length ca. 22.0-25.0 μm. Pollen breath ca. 19.0-23.0 μm. Tricolporate (colpi constricted at equator). Colpus length ca. 13.0-15.0 μm, Colpus breadth ca. 4.0-5.0 μm. Pori circular, pore size 3.0 μm diameter. Mesocolpium ca. 15.0 μm.

Exine ca. 2.0 μm. Sexine tectate, ca. 1.0 μm thick in the centre of mesocolpium gradually thinner towards apertures. Nexine ca. 1.0 μm, nexine almost equal to sexine.

Taxonomic remarks: Pollen grains size small but some grains are more than 24.00 μm in length. Pollen grains similar to *S.adpressa* and *S.procumbens*. Moreover in this case the sexine is equal in thickness to nexine and this character is in close resemblance with *S. procumbens* and *S.adpressa*. Though the sexine and nexine thickness is also equal in *S. micropetala* but the size of grains in *S. micropetala* is smaller than *S. trullifolia*. Known only from the type locality sikkim

Results and Discussion

The application of pollen morphology to the Plant Systematics is comparatively recent trend. The pollen morphology has proved to be a valuable tool in plant taxonomy. Pollen morphology was not considered in the earlier taxonomic studies, and is over looked in descriptions and revisions of plant taxa. The discovery of Scanning Electron Microscope has revolutionized the study of the surface structure by providing a greater depth of focus, which was never possible with the Light Microscope. With the help of Scanning Electron Microscope the palynology now have the means to fully exploit the morphological characters of the pollen grains.

The potential influence of pollen morphology on the classification of flowering plants cannot be over emphasized. Rajput *et al*., (1997) while reviewing the genus *Sibbaldia* at world level examined almost all the available collection and has recognized only 10 species. They have merged the species such as *S. cuneata, S. macrophylla, S. maxima* etc into *S. procumbens*.

Rajput *et al*., (1997) Consider that the characters vary throughout the range. They were of the opinion that plants found in various political entities show character, which overlaps and hence they should not be treated as different species on the basis of political demarcation.

Pollen material for *S. tenuis* and *S. unguiculata* was not available for present studies. The present findings are inconformity with Rajput *et al*., (1997). While studying the pollen characters during present work it was revealed that the specimens collected from various political entities for a particular species show almost no variations among themselves.

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