

POLLEN FLORA OF PAKISTAN – XXXVIII. PLANTAGINACEAE

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Abstract

Pollen morphology of 14 *Plantago* species of the family Plantaginaceae from Pakistan have been examined by light and scanning electron microscope. Plantaginaceae is a stenopalynous family. Pollen grains are generally free, radially symmetrical, apolar, porate. Shape of pollen grains are spheroidal. Sexine thicker or thinner than nexine. Tectum areolate or scabrare. The pollen morphology of the family Plantaginaceae is significantly helpful at specific level. On the basis of exine ornamentation 2 distinct pollen types viz., *Plantago* - *major* and *Plantago* - *ovata*-type are recognized.

Introduction

Plantaginaceae is a small family of c. 3 genera and 275 species, chiefly of north temperate zone and south East Africa (Mabberley, 1987). In Pakistan it is represented by a single genus *Plantago* with 20 species (Kazmi, 1974). The genus *Plantago* is characterized by herbaceous habit; leaves in a basal rosette with prominent parallel veins; spicate or capitate inflorescences or wiry scapes; flowers 4-merous; corolla membranous; stamens often exerted. Seeds of *Plantago psyllium* are used as a laxative. Considerable work has been done on the pollen morphology of the family Plantaginaceae. The earliest report is that of Erdtman (1952), Kapp (1969), Serbanescu-Jitariu (1971), Solomon *et al.*, (1973), Rao & Shukla (1975), Moore & Webb (1978), Kuprianova & Alysoshina (1978). Markgraf & Dantoni (1978) who studied the pollen of Plantaginaceae. In all these studies no attempt has been made to correlate the pollen characters with the taxonomy of the family. There are no reports on pollen morphology of various species of Plantaginaceae found in Pakistan. Present study is based on pollen morphology of the 14 species of the genus *Plantago* by light and scanning electron microscope. An attempt has been made to correlate the pollen characters with the taxonomy of the genus.

Materials and Methods

Pollen samples were obtained from Karachi University Herbarium (KUH) or collected from the field. The list of voucher specimens are deposited in KUH. The pollen grains were prepared for light (LM) and scanning microscopy (SEM) by the standard methods described by Erdtman (1952). For light microscopy, the pollen grains were mounted in unstained glycerin jelly and observations were made with a Nikon Type-2 microscope, under (E40, 0.65) and oil immersion (E100, 1.25), using 10x eye piece. For SEM studies, pollen grains suspended in a drop of water was directly transferred with a fine pipette to a metallic stub using double sided cello tape and coated with gold in a sputtering chamber (Ionsputter JFC-1100). Coating was restricted to 150A. The S.E.M examination was carried out on a Jeol microscope JSM-T200. The measurements are based on 15-20 readings from each specimen. Polar length, equatorial diameter, pore diameter and exine thickness are given in (Table 1 and 2).

Table 1. General pollen characters of species found in pollen type *Plantago major*.

Name of taxa	Diameter in μm	No. of Pore	Operculum	Annulus	Pore diameter μm	Exine thickness μm
<i>Plantago major</i> L.	25.5 (26.7) 27.5	8	+	+	2.25 (2.14) 2.75	1.25 (1.91) 2.5
<i>P. depressa</i> Willd.	22.5 (24.23) 26.25	10-12	+	+	2.25 (2.69) 2.75	1.25 (2.03) 2.5
<i>P. atrata</i> Hoppe	19.5 (29.48) 29.7	3-4	-	-	1.65 (1.74) 2.47	1.65 (2.11) 1.58
<i>P. amplexicaulis</i> Cav.	22.5 (25.52) 30	Pantoporate	+	+	2.0 (2.33) 2.5	1.25 (1.35) 2.75
<i>P. lanceolata</i> L.	15.1 (20.6) 23.5	Pantoporate	+	+	2.25 (2.37) 2.75	1.25 (1.35) 2.75
<i>P. stocksii</i> Boiss ex Decn.	20.0 (23.76) 26.25	Pantoporate	-	+	0.75 (1.15) 2.0	0.75 (1.15) 2.0
<i>P. exigua</i> Murray	25.0 (26.65) 27.5	Pantoporate	+	+	1.25 (3.75) 1.24	1.25 (1.25) 1.51

Table 2. General pollen characters of species found in pollen type *Plantago ovata*.

Name of taxa	Diameter in μm	No. of Pore	Operculum	Annulus	Pore diameter μm	Exine thickness μm
<i>Plantago himalaica</i> Pilger	19.8 (22.1) 23.1	Porate	+	+	1.65 (1.87) 2.24	16.5 (2.03) 2.47
<i>P. cylindrica</i> Forssk.	19.8 (22.6) 23.1	Pantopont	+	+	1.65 (1.76) 3.3	1.65 (2.2) 22.47
<i>P. ovata</i> Forssk.	19.8 (23.17) 29.7	Pantoporate	+	+	0.7 (0.85) 1.65	0.66
<i>P. longifolia</i> L.	22.1 (24.42) 29.7	Pantoporate	+	+	1.65 (2.47) 3.3	1.65 (1.8) 1.47
<i>P. ciliata</i> Desf.	23.7 (24.93) 27.5	Pantoporate	+	+	2.25 (2.48) 2.5	1.25 (1.88)
<i>P. indica</i> L.	23.1 (25.90) 29.6	Pantopoti	+	+	1.65 (1.76) 3.3	2.25

The terminology used is in accordance with Erdtman (1952); Faegri & Iversen (1964); Kremp (1965) and Walker & Doyle (1976).

Observations

General pollen characters of the family Plantaginaceae

Pollen grains usually radially symmetrical, apolar, spheroidal to oblate – spheroidal, pantoporate, \pm circular operculate or non-operculate, annulate or non-annulate. Sexine thicker or thinner than nexine. Tectum generally areolate to scabrate.

Key to the pollen types

- 1. + Tectum areolate *Plantago major* –type
- Tectum scabrate *Plantago ovata* – type

Plantago major– type (Fig. 1 A-D; Fig. 2 A & B)

Pollen class: Pantoporate.

P/E ratio: Adequate.

Shape: Spheroidal.

Aperture: Pori-small, circular with or without operculum.

Exine: Sexine thicker than nexine.

Ornamentation: Tectum areolate, scabrae coarse or fine.

Outline: More or less circular.

Measurements: Equatorial diameter 15.1 (16.1 \pm 1.25) 30.0 μ m, and pore more or less circular, diameter 0.75- (4.5 \pm 0.31) 3.75 μ m. operculate or non-operculate. Pore plate scabrate. Sexine thicker than nexine. Exine 0.75- (2.33) 2.47 μ m thick.

Species included: *Plantago major* L., *P. depressa* Willd., *P. atrata* Hoppe, *P. amplexicaulis* Cav., *P. lanceolata* L., *P. stocksii* Boiss ex Decne, *P. exigua* Murray.

Key to the species and species group

- 1. + Pollen grains non-operculate 2
- Pollen grains operculate *P. exigua*
- group (*Plantago major*, *P. depressa*, *P. amplexicaulis*, *P. lanceolata*, *P. exigua*)
- 2. + Pollen grains 3-4 porate *P. atrata*
- Pollen grains pantoporate *P. stocksii*

Plantago ovata– type (Fig. 2 C & D)

Pollen class: Pantoporate.

P/E ratio: Adequate.

Shape: Spheroidal.

Aperture: Pori-small, circular with operculum and annulate.

Exine: Sexine thicker than nexine.

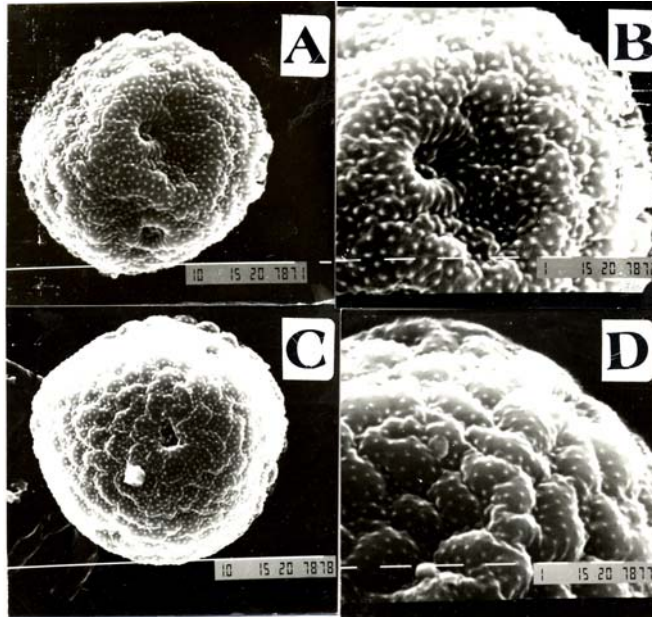


Fig. 1. Scanning micrographs: *Plantago amplexicaulis*: A, Pollen grain; B, Exine pattern. *P. exigua*: C, Pollen grains, D, Exine pattern.
Scale bar = A, C = 10; B & D = 1 μ m.

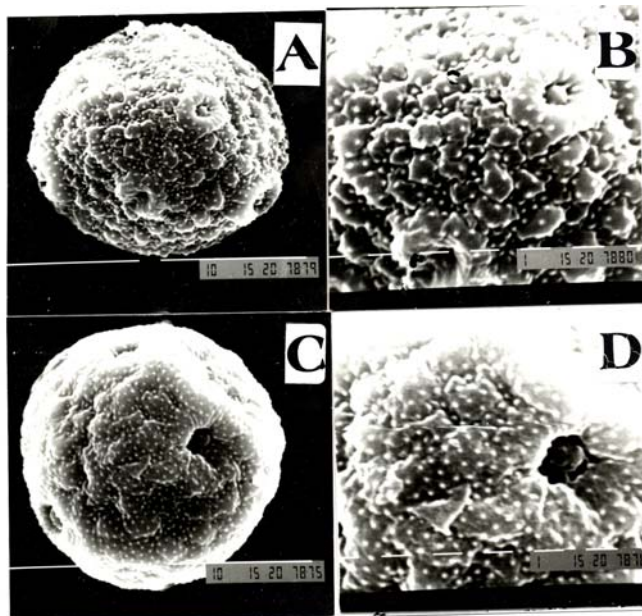


Fig. 2. Scanning micrographs: *Plantago lanceolata*: A, Pollen grain; B, Exine pattern. *P. ciliata*: C, Pollen grains, D, Exine pattern.
Scale bar = A, C = 10; B, D = 1 μ m.

Ornamentation: Tectum scabrate, scabrae coarse or fine.

Outline: More or less circular.

Measurements: Equatorial diameter 19.8 (24.5 ± 1.25) 29.6 μm , and pore more or less circular, 0.7- (2.01 ± 0.31) 3.33 μm , operculate and annulate. Pore plate scabrate. Sexine thicker than nexine. Exine 0.66- (3.4 ± 0.31) 2.47 μm thick.

Species included: *Plantago himalaica* Pilger, *P. cylindric* Forssk, *P. ovata* Forssk, *P. loeflingii* L., *P. ciliata* Desf., and *P. indica* L.

Key to the species

- 1. + Exine 0.66 μm thick *Plantago ovata*
- Exine 1.2-2.47 μm thick *P. indica*
- group (*Plantago himalaica* , *P. cylindric* , *P. loeflingii*, *P. ciliata* and *P. indica*).

Discussion

Plantaginaceae is stenopalynous family (Erdtman, 1952). Pollen grains of Plantaginaceae are characterized by apolar, spheroidal, operculate to non operculate, annulate to non annulate, pantoporate with scabrate or areolate tectum. Pollen of all the 14 species, belonging to a single genus i.e., *Plantago* are remarkably uniform in their pollen characters. However, species of *Plantago*, show little variation in their tectum type. On the basis of tectum two distinct pollen types are recognized viz., *Plantago major* and *Plantago ovata* . Pollen type: *Plantago- major* is readily distinguished by its areolate tectum in which 7 species viz., *Plantago major* L., *P. depressa* Willd, *P. atrata* Hoppe, *P. amplexicaulis* Cav., *P. lanceolata* L., *P. stocksii* Boiss ex Decne, and *P. exigua* Murray are included. On the basis of presence and absence of operculum and numbers of pores these species are further divided into two species and one species group. (see key to the species group). Pollen type: *Plantago ovata* is delimited by its scabrate tectum. In the *Plantago ovata* – type, 6 species viz., *Plantago himalaica* Pilger, *P. cylindric* Forssk, *P. ovata* Forssk, *P. loeflingii* L., *P. ciliata* Desf., and *P. indica* L., are included. Similar to *Plantago major*- type, this pollen type is also further divided into two group on the basis of exine thickness. In one group pollen grains have 0.66 μm thick exine, while the remaining species of this pollen type have 1.2-2.47 μm thick exine. Pollen studies clearly indicates that the genus *Plantago* is a homogenous taxon in accordance with the morphology of the genus.

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