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POLLEN MORPHOLOGICAL STUDIES IN THE ANDROSACE (PRIMULACEAE) SPECIES FOUND IN PAKISTAN

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Abstract

A total of 22 species of *Androsace* occurring in Pakistan have been studied for their pollen morphology. Although the pollen shows uniformity in shape, the pollen breadth and colpi length have been found useful at the sectional level of the genus. The pollen scanning for the species has been attempted for the first time.

Introduction

The genus *Androsace* found in the mountainous regions of the North West Frontier Province, Kashmir, Baltistan and Gilgit in Pakistan, is represented by 24 species in 4 sections. Little work on the pollen morphology of the genus seems to have been attempted since Wendelbo (1961) described the pollen for 10 species, Nair (1965) for 2 species and Punt *et al* (1974) for only 1 species of the genus found in the Himalaya. The present paper describes the pollen morphological studies in the *Androsace* found in Pakistan.

Material and Methods

The pollen from 22 species of *Androsace*, obtained directly from herbarium sheets or fresh from the field, were examined by a light compound microscope and a scanning electron microscope. Approximately 20-50 pollen grains per 3 sheets for each taxon and in some cases fewer (up to 10) from only 1 or 2 sheets, due to lack of sufficient material, were studied. For scanning, pollen were removed from the anthers of flowers, transferred to a double-sided adhesive tape mounted on a metal stub, then vaccum coated with gold in a dust chamber, examined and photographed using a JEOL JSM 35 R scanner (at Reading University, England) or a JEOL JSM 1 (at Kew, England) at 15-30 Kv. Only a few taxa, prior to scanning, were acetolysed, after the method of Erdtman (1966), then mounted in glycerine jelly stained with safranin and sealed with paraffin wax. Light microscopy was used for the study of pollen morphology, detail and size, using an Erma Standard Microscope KL-Bi-1 type. Polar length (p), equatorial breadth (e), aperture(–s) size, exine thickness, diameter of lumina, p/e ratio and the Polar Area Index (PAI) were measured for each pollen. The following are the abbreviations used: e.v. = equatorial view; p.v. = polar view; p.p. = pro parte. Terminology is mostly after Erdtman (1966).

Table 1. Pollen morphology in *Androsace*. All measurements are in μm.

Species	Length(p)	Breadth(e)	p/e ratio	Ectocolpium length	Endoaperture (l x b)	PAI
Sect. *Samuelia*						
1. *A. rotundifolia*	10.3-11.06	8.5-10.3	1.20-1.56	7.5-8.9(–12.3)	x 6	0.38-0.43
ssp. *glandulosa*	9.9-10.7	7.1-8.5	1.21-1.42	7.5-8.6	x 5.8	0.39-0.50
2. *A. thomsonii*	10.3-10.7	7.4-9.6	1.11-1.26	6.6-8.5	x 6.4	0.38-0.43
3. *A. umbellata*	10.3-11.06	7.1-7.8	1.42-1.54	7.1-7.5	x 6.0	0.42-0.47
Sect. *Androsace*						
4. *A. septentrionalis*	11.4-14.6	7.8-9.6	1.33-1.51	9.31	x 6.4	0.38-0.43
Sect. *Aizoideum*						
5. *A. aizoon*	14.2-17.4	10.7-11.4	1.28-1.40	8.0-11.5	3.7 x 7.1	0.33-0.39

Sect. *Chamaejasmae*

6.	*A. akbaitalensis*	15.0-16.4	9.4-10.7	1.57-1.78	9.0-9.8	x 7.1	0.29-0.37
7.	*A. studiosorum*	14.2-18.0	10.8-11.06	1.32-1.61	10.5-13.0	x 7.1	0.33-0.38
8.	*A. baltistanica*	13.5-16.0	10.3-11.06	1.31-1.45	8.4-9.5	x 7.0	0.78
9.	*A. duthieana*	14.0-15.0	10.3-10.7	1.29-1.37	8.5-11.5	3.5 x 7.0	0.33-0.39
10.	*A. flavescens*	15.5-16.0	9.5-10.3	1.69-1.72	10.6-12.4	x 7.1	0.28-0.31
11.	*A. foliosa*	14.5-17.8	10.9-11.06	1.32-1.65	10.5-13.5	x 7.1	0.33-0.36
12.	*A. harrissii*	13.9-14.2	9.9-10.7	1.33-1.48	6.8-8.5	3.4 x 7.1	0.40-0.47
13.	*A. hazarica*	15.0-17.8	10.7-11.4	1.32-1.61	10.0-12.4	x 7.0	0.34-0.35
14.	*A. himalaica*	14.0-15.0	10.3-11.06	1.39-1.44	8.8-12.0	x 7.3	0.35-0.39
15.	*A. lanuginosa*	14.2-17.5	10.7-11.0	1.29-1.58	9.5-11.5	x 7.1	0.33-0.36
16.	*A. mucronifolia*	14.2-17.4	10.7-11.0	1.31-1.56	9.0-11.0	3 x 7.0	0.33-0.37
17.	*A. muscoidea*	12.8-14.6	8.5-10.7	1.26-1.58	8.2-9.3	3.5 x 7.1	0.32-0.50
18.	*A. ojhorensis*	13.6-14.6	10.5-11.0	1.29-1.36	9.5-13.5	x 7.1	0.29-0.37
19.	*A. robusta*	13.5-15.0	10.7-11.1	1.25-1.33	10.0-13.0	x 7.0	0.33-0.39
20.	*A. sempervivoides*	13.5-14.6	10.3-11.0	1.26-1.37	10.2-11.0	x 7.4	0.33-0.36
21.	*A. staintonii*	13.3-14.0	8.0-8.8	1.51-1.70	10.1-11.0	x 7.1	0.38-0.43
22.	*A. villosissima*	13.5-14.9	10.3-10.7	1.31-1.39	10.0-12.0	x 7.0	0.66

Results and Discussion

The results of the pollen investigation are summarized in Table 1. The pollen grain in the genus is of the *Androsace* type (Wendelbo, 1961) and akin to that found in other primulaceous genera as *Glaux* L., *Lysimachia* L., *Anagallis* L., and *Samolus* L. The grain may be described as follows:

Pollen grains 3(–4– colporate, prolate to subprolate, p/e 1.11 – 1.65, amb broadly elliptic to rectangular with short sides obtuse (e.v.), more or less triangular to circular with intruding colpi (p.v.). Endoaperture present, distinct and lalongate, sometimes with 1-2 horns. Exine 1 μm or less in thickness, usually not well differentiated in to a sexine and nexine layer. Nexine thickened at the equator. Sexine psilate or microreticulate with lumina 0.1-0.6 μm broad in diameter. PAI 0.28-0.78.

Unlike the genus *Primula* L., no instance of heterostyly associated with dimorphic pollen was observed in *Androsace*. In the species studied there was uniformity in the pollen shape, however differences amongst various sections as regards the pollen breadth and the colpi length was observed. Wendelbo (1961) showed that the pollen size could be used to distinguish between various sections of the genus. Smallest grains are found in the sect. *Samuelia* Schlechtd., comprising of the species *A. umbellata* (Lour.) Merrill, *A. rotundifolia* Hardw. and *A. thomsonii* (Watt) Y. Nasir (Table 1, Fig. 1). Largest grains are found in the sect. *Chamaejasmae* Koch. The sect. *Androsace* with its only representive

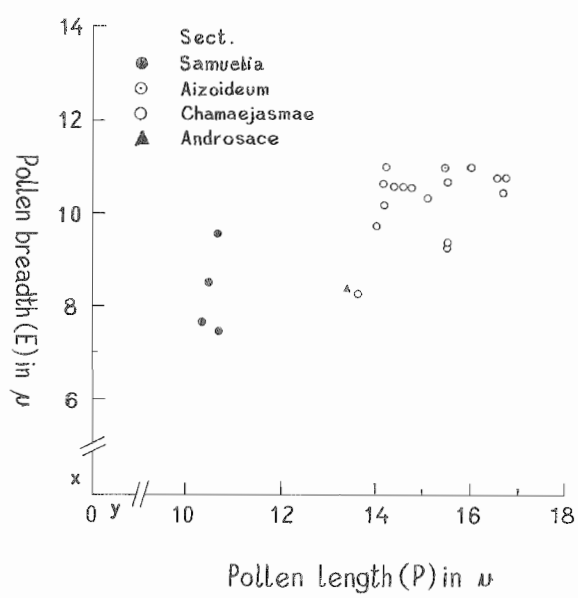

Fig. 1. Length breadth ratio of pollen in various sections of *Androsace*.

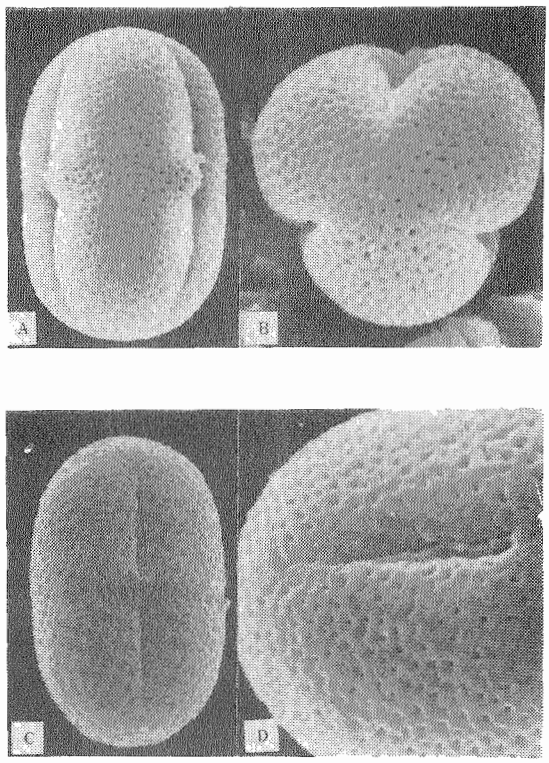

Fig. 2. Scanning Electron micrographs of a. *Androsace staintonii,* equatorial view x 5250 (*W. Koelz* 1537, RAW). b. polar view x 7800. c. *A. baltistanicus:* equatorial view x 5000 (*Stainton* 1183). d. portion of pollen grain showing sexine detail x 11000.

A. septentrionalis L., had pollen intermediate in size between sect. *Samuelia* and sect. *Chamaejasmae.* In the sect. *Aizoideum* Handel-Mazzetti, the grain size in *A. aizoon* was that noted for the sect. *Chamaejasmae.* With a gradual increase in the pollen size, a corresponding increase in the ectocolpium length was observed; in sect. *Samuelia,* the colpi length was 6.6-8.9 μm, in sect. *Chamaejasmae* from 6.8-13.5 μm. In the sect. *Aizoideum* and sect. *Androsace* the colpi length was intermediate (i.e. 8.0-11.5 μm).

The larger pollen size in sect. *Chamaejasmae* is an advancement over the sect. *Samuelia.* This is in accord with the fact that most of the species of sect. *Chamaejasmae,* and especially those with reduced scapes and few flowers, are specialised forms adapted to the environment. On the other hand the sect. *Samuelia* (= sect. *Pseudoprimula* Pax) with its forest types are considered primitive (Knuth, 1905; Handel-Mazzetti, 1927). The colpi length does not support this view, where in the sect. *Chamaejasmae* they are longer and thus considered as a primitive feature (Punt, 1976); apparently here the section has retained this primitive character. Hyunh (1971) in discussing the evolutionary tendencies in the genus *Lysimachia,* has shown several instances (in subg. *Sandwiciensa, Seleucia* and

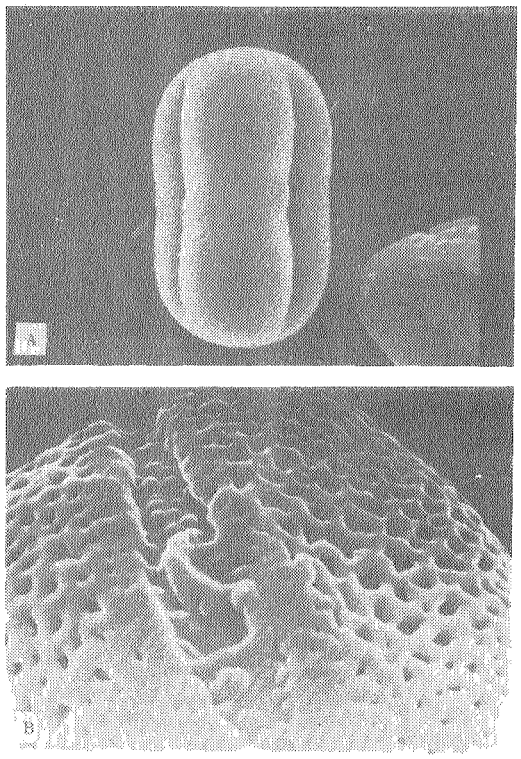

Fig. 3. Scanning Electron micrograph of a. *A. robusta:* equatorial view x 5000 (*Polunin, Sykes & Williams* 1095, BM). b. *A. himalaica* ssp. *kurramensis:* detail of colpus x 18617 (*Duthie* 14884, RAW).

Idiophyton) where the pollen has both primitive and advance features. In *Primula tibetica* Watt, the small pollen grain (primitive) has large lumina (advanced). Apart from differences in pollen size and colpi length in different sections of *Androsace,* no significant pollen morphological differences between the species was noted. Some differences in the breadth of the pollen was useful in redefining relationship within the *Androsace rotundifolia* complex (Nasir & Afzal, 1985) where subtle differences in the pollen breadth occur in *A. rotundifolia* Hardw., and *A. thomsonii.* In several species of the sect. *Chamaejasmae* (i.e. *A. duthieana* Knuth, *A. hazarica* R.R. Stewart ex Y. Nasir, *A. harrissii* Duthie, *A. muscoidea* Duby and *A. robusta* (Knuth) Handel-Mazzetti, a bridge (for difinition see Punt, 1974) was noted across the endoaperture. Other species may have it as well, but it is possible that the mode of preparation of the grains may obscure it in many cases. The occurrence of bridges is known in other families like *Boraginaceae, Lythraceae* and *Melastomaceae.* Although the pollen in *Androsace* shows little variability (i.e. stenopalynous), some features of the grain can be employed to distinguish sections of the genus (Figs. 2 & 3).

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