

PALYNOLOGICAL STUDY OF *ONOSMA* (BORAGINACEAE) FROM PAKISTAN

U.S. QURESHI* AND M. QAISER

*Department of Botany,
University of Karachi, Karachi-32, Pakistan.*

Abstract

Pollen morphology of 9 species of the genus *Onosma* from Pakistan was studied. The genus is characterized by 3-colporate pollen grains with sub-prolate to sub-oblate shape; ovate, circular and oblate equatorial outlines. The endoapertures in six species are offset from the equator whereas in 3 species endoapertures are at the equator. The tectum is echinate and granulated with perforations (puncta). The taxonomic position of the genus is discussed in the light of pollen morphology.

Introduction

Onosma is a genus with ca. 150 species (Willis, 1973) having its center of distribution and maximum concentration of species in Iran and westwards into Syria and Turkey, eastwards and northeastwards to Turkestan, Altai, China, Afghanistan, Pakistan, Kashmir, Tibet and India to Burma. It is represented by 9 taxa in Pakistan (Kazmi, 1971).

Johnston (1954) while reevaluating the genera of lithospermeae also studied pollen of 45 species of *Onosma* which includes most of the species from Pakistan. However no information is available on scanning electron microscopy of the genus. The object of this investigation was to correlate the palynological data with the taxonomy of the genus.

Materials and Methods

Polleniferous material was obtained from Karachi University Herbarium (KUH), National Herbarium Rawalpindi (RAW) and North Regional Laboratories Peshawar (PES). The following is the list of specimens examined:

1. *Onosma bracteatum*, W. Himalaya: *Inayat* 24756 (RAW)
2. *O. chitralicum*, Chitral state: *Stainton* 2216 (PES)
3. *O. dichroanthum*, Malakand: *Y. Nasir* 9036 (KUH)
4. *O. griffithii*, Sor range: *M.G. Konieczny* s.n. (KUH)
5. *O. hispidum*, Afghanistan: *S.A. Akhter* s.n. 1938 (KUH)
6. *O. khyberianum*, Khyber pass: *D. Ludlow* 709 (PES)

*Present Address: Department of Biology, Saint Patrick's Govt. College, Sangster Road, Saddar, Karachi, Pakistan.

7. *O. hypoleucum*, Hazara, Thandiani: R.R. Stewart 27788 (KUH)
8. *O. thomsonii*, Sunny bank: M. Qaiser 5623 (KUH)
9. *O. limitaneum* var. *limitaneum*, Ziarat: Nazim 675 (KUH)
10. *O. limitaneum* var. *majus*, Baluchistan: Stocks 997 (PES)

Pollen were acetolysed according to the method outlined by Erdtman (1952) and then fixed to specimen stubs with double-sided 'Sellotape'. The specimens were coated with gold in a vacuum coating unit and examined with a Jeol scanning microscope (JSM-T200).

For light microscopical work an ortholux-II (Leitz, Wetzler) microscope was used. The terminology used for pollen description is in accordance with Erdtman (1952) and Faegri & Iversen (1975).

Results

All pollen grains examined were 3-colporate, subprolate to suboblate, small sized, equatorial diameter 11-24.2 μm , polar axis 13.2-19.8 μm , P/E ratio 0.81-1.26. Polar outline rounded triangular to circular. Equatorial outline ovate, circular to oblate. Isopolar or heteropolar, if heteropolar then one pole broader than the other, poles convex, obtuse at the board end and acute at the narrow end. Colpi 8.8-13.2 μm long, narrow, parallel sided, in rounded triangular grains the colpi are at the angles with convex mesocolpia. Ovate shaped grains are syncolporate from the broader pole whereas the narrower one bears the apocolpia. Endoaperture in some species are covered by an operculum, situated closer to the wider pole or at the equator. Mesocolpia 6.6-15.4 μm , apocolpia 1.65-5.5 μm or obscure. Exine 1.1-3.3 μm thick, thicker at the apertures, tectum granulated and echinate with very small perforations (puncta) present all over the surface. Sexine as thick as nexine or thicker than nexine.

A detailed description of all the species is given in Table 1.

Discussion

The pollen grains of *Onosma* are similar to the grains of other genera of Boraginaceae viz., *Cordia*, *Lithospermum*, *Caccinia*, *Nonea* and *Trichodesma* in having 3-colporate grains (Qureshi, 1980).

On the basis of pollen morphology 2 distinct pollen types in the genus *Onosma* are recognised.

Table 1. Selected pollen morphological characters in genus *Onosma*.

Taxa	Type Shape	Length in Polar Axis (P) μm		Equatorial diameter (E) μm		Ratio (P/E)	Equatorial outline	Polar outline	Tectum	Mespium (μm)	Exine thickness (μm)	Position of Endoaperture	
		Max	Min	Max	Min								
1 <i>Onosma hispidum</i>	1 SP	—	15.4	—	13.2	—	1.16	Ovate	Rd. Triang- Cir	Echinate	8.8	1.1	—
2. <i>O. chitralicum</i>	1 SP	(15.4-)	14.7	(-14.3)	(12.1-)	11.9	(-11.0)	1.23	Ovate	Echinate	6.6	1.6-3.3	—
3. <i>O. dichroanthum</i>	1 SP	(17.6-)	16.9	(-16.5)	(14.3-)	13.8	(-12.1)	1.22	Ovate	Echinate	11.0	1.6-3.3	—
4 <i>O. griffithii</i>	1 SP	(15.4-)	14.5	(-14.3)	(13.2-)	12.3	(-12.1)	1.17	Ovate	Echinate	9.9	1.1	—
5. <i>O. bracteatum</i>	1 SP	—	16.5	—	13.2	—	1.25	Ovate	Rd. Triang- Cir	Echinate	11.0	1.1	—
6 <i>O. khyberianum</i>	1 SP	(16.5-)	15.2	(-13.2)	(13.2-)	13.0	(-12.1)	1.16	Ovate	Echinate	9.0	2.2	—
7. <i>O. hypoleucum</i>	2 Sph	(15.4-)	14.8	(-14.3)	(15.4-)	14.5	(-14.3)	1.02	Cir-Obl	Granulated	12.1	2.2	+
8. <i>O. thomsonii</i>	2 SO	—	14.3	—	16.5	—	0.86	Cir-Obl	Granulated	12.1	1.65	+	
9. <i>O. limitaneum</i> var. <i>limitaneum</i>	2 Sph	(17.6-)	16.7	(-15.4)	(17.6-)	16.5	(-15.4)	1.01	Cir-Obl	Granulated	14.3	2.75	+
10. <i>O. limitaneum</i> var. <i>majus</i>	2 SO	(19.8-)	19.3	(-18.7)	(24.2-)	23.7	(-23.1)	0.81	Cir-Obl	Granulated	15.4	2.2	+

Key to abbreviations: P = polar axis; E = equatorial diameter; SP = subprolate; Sph = sphaeroidal; SO = suboblate; Cir = circular; Obl = oblate; Rd. Triang = Rounded triangular; — = Endoaperture at equator; + = Endoaperture offset from equator.

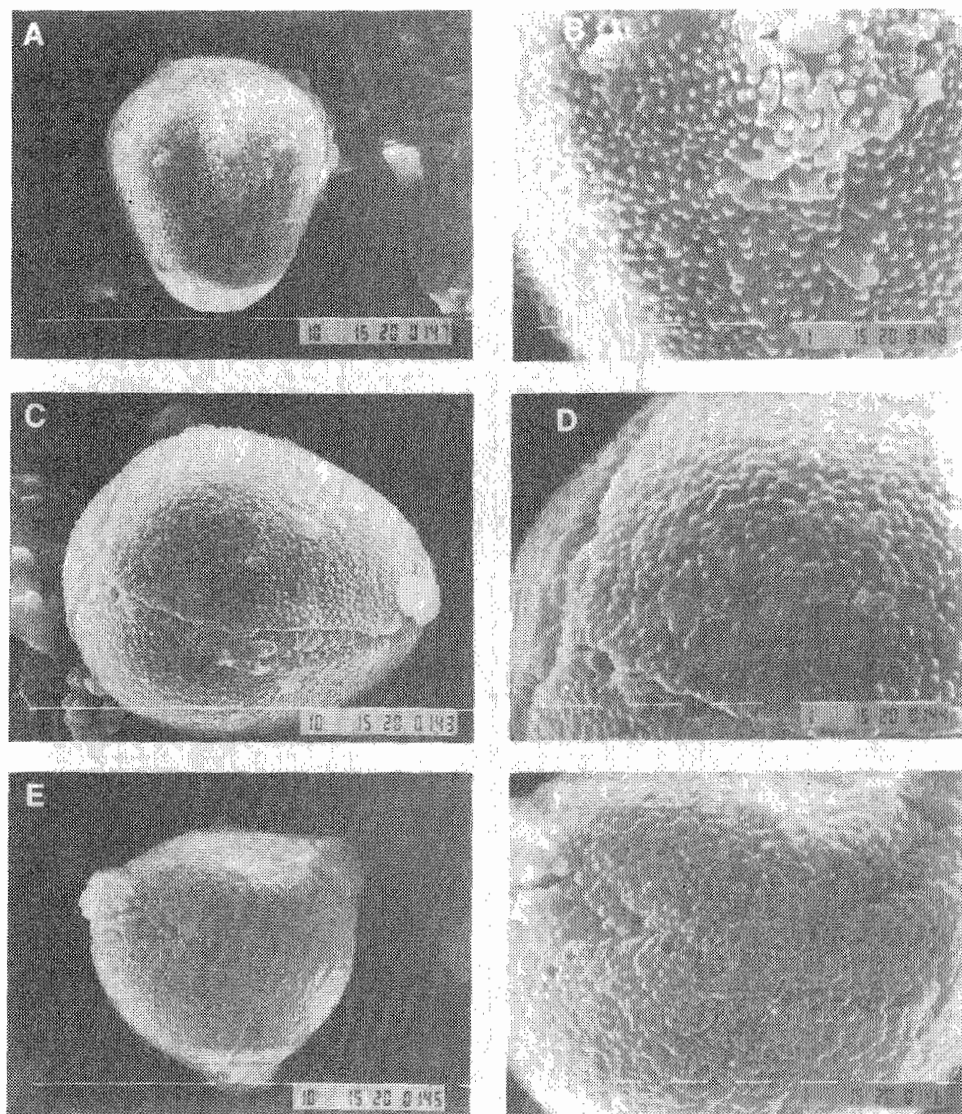


Fig. 1. Scanning micrographs of pollen of *Onosma*: A. *O. dichroanthum*, Equatorial view; B. *O. dichroanthum*, Surface pattern; C. *O. griffithii*, Equatorial view; D. *O. griffithii*, Surface pattern; E. *O. lamitaneum* var. *lamitaneum*, Polar view; F. *O. lamitaneum* var. *lamitaneum*, Surface pattern. (Fig. A, C, E each bar 10 μm ; B, D, F each bar 1 μm).

Type 1 (Fig. 1, A-D). All the pollen grains in this type basically have ovate equatorial outlines with endoapertures situated closer to the wider pole. Pollen are subprolate, heteropolar; the tectum is echinate with perforations (puncta) all over the surface. Equatorial diameter 11-14.3 μm ; polar axis 13.2-17.6 μm ; P/E 1.16-1.26. The ovate outlines of the grains are also reported in *Onosma helveticum*, *Echium* and *Alkana* (Huynh 1972, Clarke 1977, Avetisian 1956). The following 6 species viz., *Onosma bracteatum* Wall., *O. hispidum* Wall., *O. chitralicum* I.M. Johnston, *O. dichroanthum* Boiss, *O. griffithii* Vatke, and *O. khyberianum* I.M. Johnston fall into this type.

Type 2 (Fig. 1, E-F). Pollen of this type are denoted by circular to oblate equatorial outlines with endoapertures situated at the equator. The tectum is granulated with perforations (puncta) on the surface. Pollens are isopolar; sphaeroidal to suboblate in shape. Equatorial diameter 14.3-24.2 μm ; Polar axis 14.3-19.8 μm ; P/E 0.81-1.02. The remaining taxa viz., *Onosma hypoleucum* I.M. Johnston, *O. thomsonii* C.B. Clarke, *O. limitaneum* I.M. Johnston var. *limitaneum* and *O. limitaneum* I.M. Johnston var. *majus* I.M. Johnston belong to this type.

The pictorial diagram (Fig. 2) also suggests clearly that the two distinct types can be recognized and the above contention fits also very well with the taxonomy of the genus *Onosma*. All the species of type (1) are characterized by having large corolla (12-40 mm long) and with large nutlets (3-6 mm long). All the species of the type (2) have shorter corolla viz. 7-12 (-17) mm long and 2.5-3.0 (-3.5) mm long nutlets.

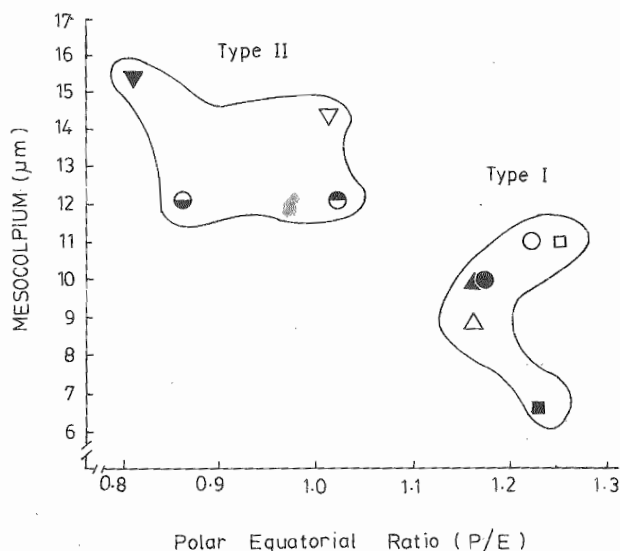


Fig. 2. Pictorial diagram showing 2 distinct pollen types: \square *Onosma bracteatum*; \blacksquare *O. chitralicum*; \circ *O. dichroanthum*; \bullet *O. griffithii*; \triangle *O. hispidum*; \blacktriangle *O. khyberianum*; \ominus *O. hypoleucum*; \oplus *O. thomsonii*; ∇ *O. limitaneum* var. *limitaneum*; \blacktriangledown *O. limitaneum* var. *majus*.

Onosma is a natural and fairly homogeneous taxon. There are very little morphological character differences which can delimit various taxa of the genus. The different sections proposed in the genus by various taxonomists such as Boissier (1875), Davis (1965), Popov (1974) and Riedl (1978) seems to be arbitrary as evident from lot of overlapping characters present in the different sections.

All the species of *Onosma* found in Pakistan fall under the section *Onosma* sub sect. *Onosma*. This section is characterized by "corolla colour various; anthers included or shortly exerted, free or coherent at base; squamules at base of filament; nutlets more or less erect". There seems to be a direct correlation in the pollen morphology, floral characters and the taxonomy of this genus. It is therefore suggested that two series in the subsection *Onosma* may be recognized.

The present study cannot be used to distinguish all the individual taxa of the genus. Nevertheless, in both the types few taxa can be delimited on the basis of certain combination of characters. *Onosma dichroanthum* and *O. bracteatum* are distinct in type 1 by having larger grains (16.5-16.9 μm) and large mesocolpium. In the former taxon the exine is thicker (1.6-3.3 μm) than the later (1.1 μm). In type 2 *Onosma limitaneum* var. *limitaneum* and var. *majus* are characterized by having large grains than *O. thomsonii* and *O. hypoleucum*. However, both the varieties can be distinguished by having different pollen shape (Table 1). Similarly *O. thomsonii* and *O. hypoleucum* are distinguishable from each other on the shape and exine thickness (Table 1).

Wodehouse (1935) and Lee (1979) have pointed out a direct correlation between flower and pollen size. However, Pandey (1971) demonstrated in the genus *Nicotiana* that there was no correlation between flower and pollen size and the species with the largest flowers had small pollen grains. The results of our present study are also in conformity with the findings of Pandey (1971). The pollen of Type 1 are smaller (11.8-13.8 μm) but with larger flowers whereas, in type 2 the grains are larger (14.5-23.7 μm) with smaller flowers.

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