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POLLEN FLORA OF PAKISTAN –LXVIII. DIPSACACEAE

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Abstract

Pollen morphology of three genera representing 6 species of the family Dipsacaceae from Pakistan has been examined by light and scanning electron microscope. Pollen grains usually radially symmetrical, isopolar, mostly prolate-spheroidal rarely spheroidal, porate or tricolpate, sexine thicker or thinner than nexine. Tectal surface mostly spinulose rarely scabrate. On the basis of apertural types 3 distinct pollen types are recognized, viz.,*Dipsacus inermis*–type, *Pterocephalus gedrosiacus*–type and *Scabiosa candollei*–type.

Introduction

Dipsacaceae a small family of about 10 genera and more or less 270 species, distributed from Europe to eastern Asia and to southern and central Africa (Mebberley, 2008). The family is characterized by having herbs or rarely subshrubs, leaves opposite, without stipules, flowers 5-merous in dense cymose heads subtended by involucral bracts, fruit achene. In north America *Dipsacus fullonum* (teasel) has become widely naturalized and weedy. Few species of the genus *Scabiosa* are cultivated as ornamental plants. Family Dipsacaceae is represented in Pakistan by 5 genera and 10 species (Nasir, 1975).

Pollen morphology of the family has been investigated by Ting (1949), Erdtman (1952), Nowicke & Skvarla (1979), Pollen morphology and the systematic position of the genus *Triplostegia* (Dipsacales) has also been examined by Backlund & Nilsson (1997). Clarke & Jones (1981) studied pollen morphology of the family Dipsacaceae from North West Europe. Mayer & Ehrendorfer (2000) carried out palynological studies in relation to taxonomy of the genus *Pterocephalus* and established a new genus *Pterocephalodes* on the basis of palynology and fruit characters. Feng *et al*., (2000) examined pollen morphology of the genus *Dipsacus* from China. Pollen morphology of some Egyptian species and its taxonomic significance has been examined by Khalik (2010).

There are no reports on pollen morphology of the family Dipsacaceae from Pakistan. Present investigations are based on the pollen morphological studies of 6 species representing 3 genera of the family Dipsacaceae by light and scanning electron microscope.

Materials and Methods

Polleniferous material was obtained from the specimens of Karachi University Herbarium (KUH). In few cases fresh material collected from the field. The list of voucher specimens is 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 were directly transferred with a fine pipette to a metallic stub using double sided cello tape and coated with gold in a sputtering chamber (Ion-sputter JFC-1100). Coating was restricted to 150 A°. The S.E.M examination was carried out on a Jeol microscope JSM-2. The measurements are based on 15-20 readings from each specimen. Pollen diameter, polar axis (P), equatorial diameter (E), aperture size and exine thickness were measured.

The terminology used is in accordance with Erdtman (1952), Kremp (1965), Faegri & Iversen (1964) and Walker & Doyle (1975).

General pollen characters of the family Dipsacaceae

Pollen grains usually radially symmetrical, isopolar, rarely polar. Shape mostly prolate-spheroidal, rarely spheroidal. Porate or ticolpate, sexine thicker or thinner than nexine. Tectal mostly spinulose, rarely echinate or scabrate. On the basis of apertural types three distinct pollen types are recognized viz., *Dipsacus inermis*–type, *Pterocephalus gedrosiacus*–type and *Scabiosa candollei*–type.

Key to the pollen types

1. \+ Pollen porate 2
   \- Pollen tricolpate ..... *Dipsacus inermis*–type

2. \+ Pollen triporate ..... *Scabiosa candollei*–type
   \- Pollen 6-12 porate ..... *Pterocephalus gedrosiacus*-type

Pollen type: *Dipsacus inermis*-type
Pollen class: 3-colpate
Pollen type: *Dipsacus inermis*
P/E ratio: 1.05
Shape: Prolate–spheroidal.
Apertures: Colpus long narrow with acute ends
Exine: Sexine thicker than nexine
Ornamentation: Spinulose sparsely echinate

Measurements: Size: P = (77.5 .72-) 88.75.80 ± 2.132 (-95.10) µm and breadth (75.5) 84.28 ± 0.9 (90.01) µm, colpi (25.95–) 28.92 ± 1.23 (35.26) µm in long. Mesocolpium 62.5-75 µm. Apocolpium 27 (32.85 ± 1.27) 37.5 µm. Exine 7.5 (9.03 ± 0.15) 10.51 µm thick, sexine thicker than nexine. Tectum spinulose sparsely echinate.
Species included: *Dipsacus inermis* Wall.

Pollen type: ***Pterocephalus gedrosiacus***-type (Fig. 1A & B).
Pollen class: 6-12-porate
P/E ratio: 101
Shape: Prolate-spheroidal
Apertures: more or less circular
Exine: Sexine thicker than nexine
Ornamentation: scabrate-punctate
Measurements: Size: Length = (21.54-) 23.47 ± 0.31 (-25.13) µm and breadth (21.54) 23.54 ± 0.27 (25.13) µm, Pore c. 359 µm long and 3.23 broad µm long. Exine 2.87 (3.21 ± 0.48) 3.59 µm thick, sexine thicker than nexine. Tectum scabrate-punctate.
Species included: *Pterocephalus gedrosiacus* Rech. f., Aellen & Esfandiari

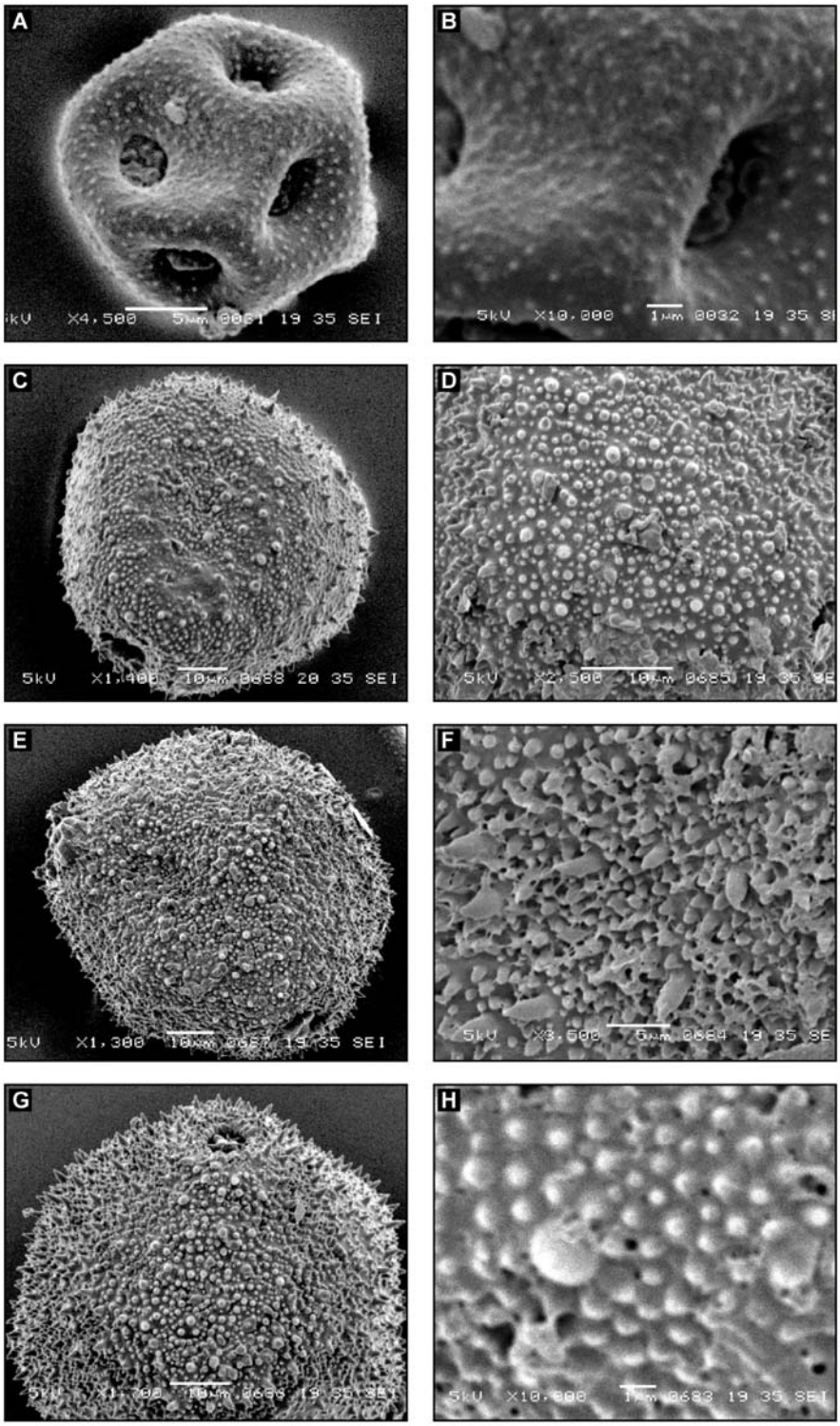

Fig. 1. A-B. *Pterocephalus gedrosiacus*: A, Pollen grains, B, Exine pattern; C-D. *Scabiosa speciosa*: C, Pollen grain, D. Exine pattern; E-F. *Scabiosa olivieri*: E, Pollen grain, F, Exine pattern; G-H. *Scabiosa maslakhensis*: G, Pollen grain, H, Exine pattern.

Pollen type: *Scabiosa candollei*-type (Fig. 1C-H)
Pollen class: 3-porate
P/E ratio: 102
Shape: Prolate-spheroidal
Apertures: More or less circular
Exine: Sexine thicker than nexine
Ornamentation: Echinate-spinulose
Measurements: Size: Length = (95-) 115.1 ± 2.31 (-125.0) µm and breadth (97) 11 2.72 ± 0.27 (25.13) µm, Pore c. 15-20 long 10-15 broad. Exine 12.87 (13.83 ± 0.48) 16.25 µm thick, sexine thicker than nexine. Tectum echinate-spinulose, spinules unequal.
Species included: *Scabiosa candollei* DC., *Scabiosa maslakhensis* Y. Nasir, *Scabiosa olivieri Coult., Scabiosa speciosa* Royle.

Discussion

Dipsacaceae is a small family. It is a eurypalynous family as the pollen morphology is quite heterogenous, Pollen grains are generally prolate–spheroidal, spheroidal, porate rarely tricolpate with spinulose-scabrate tectum..Within the family six species have been examined, distributed in three genera i.e., *Dipsacus, Pterocephalus* and *Scabiosa*. Apertural types are the most significant pollen characters. On the basis of aperture types family is divided into three pollen types viz., *Dipsacus inermis*–type, *Pterocephalus gedrosiacus*–type and *Scabiosa candollei*–type. All the genera have different apertural types such as *Pterocephalus* has 6-12 porate pollen. *Dipsacus* has tricolpate pollen.While in the genus *Scabiosa* triporate apertures are found. Tectum is also significantly distinct. For instance, the tectal surface in *Pterocephalus gedrosiacus* is scabrate and sparsely punctate, while remaining taxa have densely spinulose and sparsely echinate surface. Erdtman (1952) also divided the family Dipsacaceae in two groups on the basis of spinulate and non spinulate sexine. Clarke & Jones (1981) divided the northwest European species of the family Dipsacaceae into 4 pollen types on the basis of aperture viz, *Dipsacus fullonum*-type, *Knaution arvensis*-type, *Scabiosa columbaria*–type and *Succisa pratensis* type. Our results are in agreement with that of Clarke & Jones (1981) who have also observed porate and colpate pollen in Northwest European species of *Scobiosa* and *Dipsacus* respectively.

Moreover, they observed that the exine ornamentation consisted of two sizes of echinae viz., echinate or microechionate. In the present study we have observed echinate – spinulose tectum in *Dipsacus* and *Scabiosa* type where as in *Pterocephalus* type the tectum is scabrate punctuate. Feng *et al*., (2000) studied pollen of 17 species of the genus *Dipsacus* and divided the genus into three pollen types based on exine ornamentation viz., .dispinulate-reticulate, spinulate–foveolate and dispinulate or rarely smooth. He further reported that pollen morphology was little helpful at specific level. Present findings of Feng *et al*., (2000) cannot be substantiated here as the present investigations are based on one species of the genus *Dipsacus.* Khalik (2010) reported 3- porate pollen in *Scabiosa* and *Pterocephalus* where as in our species of *Pterocephalus* the pollen are 6-12 porate. Molecular data including sequence data from the chloroplast genes rbcL (Donoghue *et al*., 1992) and ndhF (Pyck *et al*., 1999), restriction site data (Downie & Palmer, 1992), support the close relationships of Dipsacaceae and Valerianaeae and consider Valerianaceae as a sister group to Dipsacaceae. Both these herbaceous groups are united by having distinctive pollen morphology and chlorophyllous embryos, a trait unique within Dipsacales (Backlund & Bremer, 1997).

The present palynological investigations are quite helpful at generic level as all the three genera viz., *Dipsacus, Pterocephalus* and *Scabiosa* fall in three different pollen types.

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