

PALYNOLOGICAL OBSERVATIONS ON THE GENERAL *ZOEGIA*, *COUSINIA* AND *CARDUUS* IN THE TRIBE CYNAROIDEAE (COMPOSITAE) FROM PAKISTAN

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ABSTRACT

Pollen morphological characters of the species *Zoegia purpurea* Fresen., *Cousinia minuta* Boiss and *Carduus edelbergii* Rech.f. of the tribe Cynaroideae have been studied from Pakistan. Pollen grains are semi-angular in polar view and prolate to spheroidal in equatorial view. Number of spine rows between colpi are 4 to 7 while spines are absent in *Cousinia minuta* Boiss and *Zoegia purpurea* Fresen. is characterized by lower exine value (3.1 μ) while *Cousinia minuta* Boiss. exhibited the highest exine value (9.8 μ). Spines are very characteristic having a groove like pattern in *Carduus edelbergii* Rech.f. Columella is well developed and tectate in *Carduus edelbergii* Rech.f. branched in *Cousinia minuta* Boiss and weakly developed in *Zoegia purpurea* Fresen.

Key words: *Zoegia*, *Cousinia*, *Carduus*, Cynaroideae, Pollen morphology, Pakistan

INTRODUCTION

Palynology is the study of pollen grains and spores of plants. Pollen and spore morphology is the borderline fields between palynology, cytology, taxonomy, geopalynology, aeropalynology, iatropalynology, pharmacopalynology, mellittopalynology and copropalynology are multiple scientific fields of palynology for the mankind. Pollen analysis has been tried as a means of tracing the history of cultivated cereals. (Erdtman, 1954). In a lecture to the Royal Society of London in 1809, Robert Brown pointed out that pollen morphology must not be neglected in plant systematics.

Compositae (Asteraceae) is a eurypalynous family (Erdtman, 1952) and most of its genera possess zonocolporate pollen (Sachdeva and Malik, 1986). The pollen grains of Compositae are helianthoid, spherical or slightly flattened, mainly tricolporate, echinate with variation in size and colpus number (Wodehouse, 1935, Skvarla *et al.*, 1977). The family presents a virtually inexhaustible field for palynological investigation (Wodehouse, 1965; Stix, 1960 and Skvarla and Larson, 1965). Some thistles, mulis as, and veronias have large, strikingly beautiful pollen grains (the polar axis may reach 100 μ or more). Sporoderm stratification, especially that of sexine, very often complicated. In *Artemisia* and other anemophilous genera the pollen grains are, as a rule considerably smaller and without spines and other ornamentations.

The family Compositae attracted botanical investigators throughout the span of history (Wodehouse, 1935). It is one of the largest families among the angiosperms with a worldwide distribution having an estimated number of over 20,000 species in over 1000 genera and has attracted and fascinated botanists for over two centuries (Heywood *et al.*, 1977). Wodehouse (1935) for the first time made a detailed morphological analysis and laid the

principles underlying the various configurations of exine surface in Compositae. Stix (1960) and Skvarla *et al.* (1977) added the uniqueness of exine architecture of Compositae for significant contribution in taxonomy and palynology. An array of workers viz. Huang (1972), Nair (1965), Rao and Shukla (1975), Chopra and Nair (1965), Tomb *et al.* (1974), Feuer and Tomb (1977), Pinar and Donmez (2000), Clark *et al.* (1980), Cilliers (1991), Nakajima and Monteiro (1995) studied pollens of Compositae.

Reviews of pollen (Heslop-Harrison, 1969; Stanley and Linsken, 1974; Mascarenhas, 1975), evolutionary and chemical aspects of pollen and spore wall (Ferguson and Muller, 1976) and palynology in general (Mantel, 1970) have published their work on Compositae. However, a little work has been conducted on palynology in Pakistan. Zahur *et al.* (1978), Malik *et al.* (1964), Meo *et al.* (1988ab, 1989), Meo (1999), Nasreen and Khan (1998), Dawar *et al.* (2002), Mumtaz *et al.* (2000) and Parveen (2002) reported palynologically on different families in Pakistan.

The purpose of this research work is to investigate range of pollen morphological characters in tribe Cynaroideae of the family Compositae from Pakistan.

MATERIALS AND METHODS

Pollen samples were obtained from the plants of Herbarium of Quaid-i-Azam University, Islamabad (ISL). The slides were prepared by Erdtman's method of acetolysis (1952). Florets were treated in acetic acid for five minutes. For light microscopy, the pollen grains were mounted in glycerin jelly and observation were made with a Nikon-Labophot microscope under oil immersion. Polar axis (P), equatorial diameter (E), P/E ratio, exine thickness, spine length, number of spine rows between colpi, shape in equatorial view, shape in polar view and aperture types were measured. The terminology is in accordance with Erdtman (1952), Kremp (1965), Mesfin *et al.*, (1995), Punt *et al.*, (1994), Salgado-Laboriau (1982) and Walker and Doyle (1975). The permanent slides of *Zoegia purpurea*, *Cousinia minuta* and *Carduus edelbergii* have been placed in the pollen reference collection of the Department of Biological Sciences, Quaid-i-Azam University, Islamabad.

RESULTS AND DISCUSSION

Table 1 summarizes the light microscopic measurements of pollen grains from the taxa examined. Light microscopic micrographs of the species are presented in Fig.1.

Size: Pollen grain size (Polar –equatorial diameter excluding spines) of Cynaroideae ranges from 26.8/28.1 μ to 44.4/40.1 μ . There is a great variation in the size of the pollen grains. Largest sized pollens are recorded in *Carduus edelbergii* and the smallest sized pollens are recorded in *Zoegia purpurea*. The lowest P/E ratio is 0.95 in *Z.purpurea* and highest P/E ratio (1.11) is recorded in *C.edelbergii*.

Symmetry and Shape

The pollen grains are trizonocolporate. The ora is lalongate. Aperture type is lacunate in *Zoegia purpurea*, *Cousinia minuta* and lacunate in *Carduus edelbergii*.

Apertural membrane is *spinate*. Colpi is large in *C.edelbergii* and *Cousinia minuta* and short in *Zoegia purpurea*.

Spines

The spines are absent in *Cousinia minuta* while these are present in *Zoegia purpurea* and *Carduus edelbergii*. Spines are very characteristic having a groove like pattern in *Carduus edelbergii*.

Pollen spines are conical with broad base in *Carduus edelbergii*. However in *Zoegia purpurea* pollen spines are short and not well developed. The number of spine rows between colpi varies from 4-6 in *Zoegia purpurea* and 4-7 in *Carduus edelbergii*. Columella is weakly developed in *Zoegia purpurea*, well developed and tectate in *Carduus edelbergii* and branched in *Cousinia minuta*.

Exine

The exine thickness varies among the species. Highest exine thickness value (9.8 μ) is recorded in *Cousinia minuta*, intermediate value (5.2 μ) in *Carduus edelbergii* and has a lowest value (3.1 μ) in *Zoegia purpurea*. Surface view of pollen sculpturing is echinate in *Zoegia purpurea*, *C.edelbergii* and scabrate in *Cousinia minuta*. Sexine is prominent and much thicker than nexine in *Carduus edelbergii*. Sexine is weakly divided into three layers in *Zoegia purpurea* while sexine is divided into three prominent layers in *Cousinia minuta*. Sexine is much larger than nexine in *Cousinia minuta* as compared to *Zoegia purpurea*.

Key to the species of tribe Cynaroideae

1. Pollen spines absent ----- *Cousinia minuta*
1. Pollen spines present ----- 2
2. Exine 3.1 μ ----- *Zoegia purpurea*
2. Exine 9.8 μ ----- *Carduus edelbergii*

DISCUSSION

Pollen morphological characters are helpful for classification of the taxa of a large family like Compositae. Tomsovie (1997) utilized pollen character as additional information for systematic purposes. He noted that the species of *Echinops* are similar in their main characters. Nevertheless one of them is an exception: *E.strigosus* L. distributed in the Mediterranean. The pollen grains are almost rounded, Ca. 40 μ in diameter and the ectexine is simple with unbranched baculae. On the basis of all available characters he considered this species as a separate genus *Psectra* containing one species only. *Cousinia minuta* and *Carduus edelbergii* of the tribe Cynaroideae have been studied to explore palynological characters. *Cousinia minuta* reveals a wide variation due to absence of spines which would probably be helpful to place this genus with some other tribe in the classification of the family Compositae. Pinar and Dönmez (2000) noted that spine cavities of pollen exine can be utilized as diagnostic characters in the genera of Compositae.

In *Carduus edelbergii* the spines are characteristic in having a groove like pattern and sexine is much thicker than nexine. Tofts (1999) described that pollen grain of *Carduus eriphorus* L. is spiny, circular to weakly three angled and 40-70 μ m in diameter in polar view, circular to slightly ellipsoid in meridian view. However, in the species *Zoegia purpurea* spines are shorter than *Carduus edelbergii* and groove like pattern is absent in the species *Zoegia purpurea*. There is variation in pollen size having low P/E ratio (0.95) in *Zoegia purpurea* and highest P/E ratio (1.11) in *Carduus edelbergii*. In *Cousinia minuta* sexine is divided into three layers with branched columella while in *Zoegia purpurea* columella is weakly developed. Pollen shape, aperture type and sculpturing are usually very useful taxonomic characters in the family Compositae. Hall (1928) and Clark *et al.* (1980) studied the Asteraceae and distinguished some genera on the basis of pollen characters. Huang (1972) used pollen characters as an additional aid for systematic purposes. Tomb *et al.* (1974) suggested that pollen characters particularly those of

aperture region are taxonomically useful in subtribe and the acetolyzed material gives more useful information than untreated pollen.

Cousinia minuta is distinct due to prolate pollen with scabrate surface while *Carduus edelbergii* has spheroidal pollen with non-lacunate aperture. On the basis of pollen types the species of the tribe Cynaroideae can be segregated into two groups having pollen grains with spines i.e. *Zoegia purpurea* and *Carduus edelbergii* and the pollen without spines i.e. *Cousinia minuta*. Dawar *et al.* (2002) on the bases of pollen characters grouped 22 taxa under the major pollen types in *Inula*. P/E ratio is a useful taxonomic character to show a range of variation in different taxa. *Zoegia purpurea* has the lowest P/E ratio (0.95) while the highest P/E ratio is found in *Carduus edelbergii* (1.11).

Table-1. Pollen measurements, Shape and Sculpture feature in tribe Cynaroideae

(All measurements are in microns)

Taxon	Equatorial View μ	Polar View μ	P/E ratio μ	Exine thickness	No. of Spine rows between colpi	Spine length μ	Shape in Equatorial view	Shape in Polar view	Aperture type	Class	Sculpturing
<i>Zoegia purpurea</i> Fresen	28.1 (24-31)	26.8 (27-27.5)	0.95	3.1 (2.5-4)	4-6	Semi-angular	Prolate-spheroidal	Lacunate	Lacunate	Trizonocolporate	Echinate
<i>Cousinia minuta</i> Boiss	32.8 (29-36)	33.8 (29-37.5)	1.03	9.8 (7.5-11.5)	Spines absent	Semiangular	Prolate	Lacunate	Lacunate	Trizonocolporate	Scabrate
<i>Carduus edelbergii</i> Rech.f	40.1 (39-42.5)	44.4 (42.5-50)	1.11	5.12 (4-6)	4-7	Semiangular	Spheroidal	Non-lacunate	Non-lacunate	Trizonocolporate	Tubinate

Appendix-1. Source of pollen material used in this study

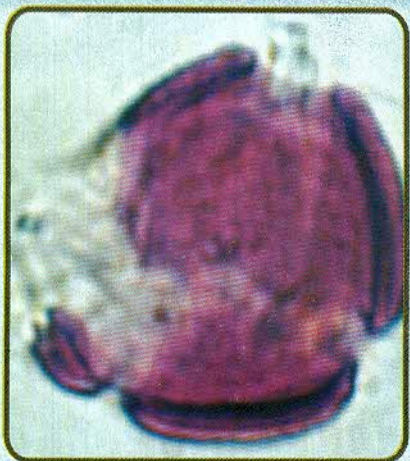
TAXON	Locality	District	Voucher No.	Collected by	Date of Collection
<i>COUSINIA Minuta</i> Boiss.	Masting	Khot	1194	Muquarreb Shah Wali-ur-Rehman	22.5.1979
	Zangiabad	Chaghi	2575	Muquarreb Shah Wati-ur-Rehman	26.4.1980
	Dirkot	Ponch	1165	Bashir Ahmad Javaid	25.5.1979
<i>CARDUUS Edelbergii</i> Rech.f.	Pachae	Chitral	773	Nadir Khan.	4.6.1974
	Kuldanna	Rawalpindi	66	Iqbal Dar <i>et al.</i>	20.5.1975
	Rattigali Nullah	Muzaffarabad	1336	Shahzad Iqbal & M. Ayaz	15.6.1978
<i>ZOEGIA Purpurea</i> Fresen.	Daru	Quetta	2493	Muquarreb Shah and Wali	24.4.1980
	Shaldarra	Quetta	532	Muquarreb Shah and Wali	9.5.1979



Zoegia purpurea (Polar view)



Zoegia purpurea (Equatorial view)



Cousinia minuta (Polar view)



Cousinia minuta (Equatorial view)

Fig. 1. Light micrograph of pollen grains of Tribe Cynaroideae (X 1000)



Carduus edelbergii (Polar view)



Carduus edelbergii (Equatorial view)

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