

POLLEN FLORA OF PAKISTAN –XVIII. AMARANTHACEAE

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Abstract

Pollen morphology of 18 species belonging to 10 genera of the family Amaranthaceae has been investigated using light microscope and scanning electron microscope. It is stenopalynous in nature. Pollen grains mostly oblate-spheroidal, pantoporate, \pm circular, pores small or large, non-operculate, or operculate, with rounded or star-like operculum, pore plate \pm scabrate - spinulose. Tectum sparsely to densely scabrate, often spinulose. On the basis of exine ornamentation 2 distinct pollen types viz., *Amaranthus viridus* type and *Gomphrena celosioides* - type are recognized.

Introduction

Amaranthaceae is a large and almost exclusively tropical family containing of c. 65 genera and over 1000 species, including many cosmopolitan "weeds" and a large number of xerophytic plants (Willis, 1973; Mabberley, 1987). In Pakistan it is represented by 12 genera and 34 species, out of which 3 species are cultivated (Townsend, 1974).

Amaranthaceae is usually divided into two subfamilies Amaranthoideae and Gomphernoideae on the basis of anther locules and number of ovules (Cronquist, 1981). Tsukada (1967) studied pollen of Chenopods and Amaranthus by electron microscope. Pollen grains of the family have also been studied by Radulescu (1974). Livingstone *et al.*, (1974) described the pore ornamentation of the family Amaranthaceae. Vishnu-Mittre (1963); Nair & Rastogi (1966) studied the pollen grains of the family of Amaranthaceae from India. Nowicke (1975) while studying the pollen of the order Centrospermas also studied some members of the family Amaranthaceae. Pollen morphology of the family Amaranthaceae have also been examined by Erdtman (1952); Buxbaum (1961), Behnke (1969), Riollet & Bonnefile (1976), Skvarla & Nowicke (1976), Nowicke & Skvarla (1977, 1979). The present report describes the pollen morphology of 18 species belonging to 10 genera of the family Amaranthaceae found in Pakistan.

Materials and Methods

Pollen samples were obtained from Karachi University Herbarium (KUH) or collected from the field. The list of voucher specimens is deposited in KUH. The pollen grains were prepared for light (LM) and scanning electron microscopy (SEM) by the standard methods described by Erdtman (1952). For light microscopy, the pollen grains were mounted in unstained glycerine jelly and observations were made with a Nikon Type-2 microscope, under (640, 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 cellotape and coated with gold in a sputtering chamber (Ion-sputter JFC-1100). Coating was restricted to 150A. The S.E.M examination was carried out on a Jeol microscope JSM-T200. The measurements were based on 15-20 readings from each specimen. Pollen diameter, pore diameter and exine thickness were measured (Table 1-2).

Table 1. General pollen characters of species found in the pollen type *Amaranthus viridus*.

Name of taxa	Diameter of pollen		Aperture No.	Diameter of pore		Exine thickness	Tectum
	μm	μm		μm	μm		
<i>Achyranthus bidentata</i> Blume	12.75(14.04±0.49)		Pantoporate	0.75(1.81±1.09)		0.7(1.81±1.09)	Fscb
	15.5			2.5		2.5	
<i>A. aspera</i> L.	16.80(19.07±0.28)		Pantoporate	1.54(1.77±0.08)		1.26(1.48±0.03)	Desb
	22.41			2.12		1.54	
<i>Aerva lanata</i> (L.) Juss. & Scultres	14.95(15.67±1.01)		Pantoporate	3.4(4.25±13.50)		c. 1.15	Scb
	17.95			5.0			
<i>A. pseudo-tomentosa</i> Blatt. & Hall.	17.95(19.81±0.22)		Pantoporate	3.59(4.48±0.40)		1.79(2.42±0.20)	Scb-punt
	18.21			5.38		3.25	
<i>A. sanguinolenta</i> (L.) Blume	15.95(16.22±0.37)		Pantoporate	2.59(3.87±0.24)		1.25(3.46±0.10)	Scb
	17.15			4.75		3.25	
<i>Amaranthus graecizans</i> L.	19.61(23.11±0.51)		Pantoporate	1.54(1.63±0.05)		1.41(1.47±0.02)	Dscb
	25.13			1.68		1.54	
<i>A. hybridus</i> L.	17.91(23.73±1.01)		Pantoporate	c. 1.16		3.23(3.43±0.05)	Dscb
	23.13					3.61	
<i>A. spinosus</i> L.	21.51(25.21±0.31)		Pantoporate	c. 2.69		1.79(2.65±0.24)	Dscb
	28.72					3.61	
<i>A. tricolor</i> L.	20.25(23.95±1.39)		Pantoporate	1.25(2.04±0.02)		1.75(2.06±0.34)	Dscb
	21.21			2.25		2.25	
<i>A. viridus</i> L.	16.8(19.2±0.52)		Pantoporate	2.11(2.54±0.08)		1.41(1.90±0.71)	Dscb
	21.11			4.75		2.81	
<i>Celosia argentea</i> L.	13.21(17.07±1.21)		Pantoporate	3		2.25(2.27±0.46)	Dscb
	17.5					2.51	
<i>Deeringia amaranthoides</i> (Lan.) Merr.	13.75(16.33±0.41)		Pantoporate	2.5(2.75±0.11)		1.12(1.86±0.08)	Spseb
	17.5			3		2.25	
<i>Digera muricata</i> (L.) Mart.	25.1(26.61±0.57)		Pantoporate	2.5(3.30±0.21)		2.52(3.30±0.21)	Spseb
	30.51			3.41		3.41	
<i>Nothosaerva brachiata</i> (L.) Wight	10.1(10.46±0.12)		6-Porate	2.5(2.80±0.51)		0.75(1.10±0.06)	Spseb
	11.25			3.75		1.75	

Abbreviations: Scb= Scabrate, Punt= Punctate, Descb= Densely scabrate, Spseb= Sparsely scabrate, Fscb= Finely scabrate, Rt= Reticulate

Table 2. General pollen characters of species found in the pollen type *Comphrena celosiooides*.

Name of taxa	Diameter of pollen μm	Aperture	Aperture No.	Diameter of pore μm	Exine thickness μm	Tectum
<i>Alternanthera paronychinooides</i> St. Hill.	13.15(15.34 \pm 0.27) 17.95	6-9		2.5(3.44 \pm 0.24) 4.75	1.25(1.97 \pm 0.16) 2.25	Scb/Rt
<i>A. sessilis</i> (L.) DC	11.21(13.59 \pm 0.42) 15.41	3-3.2		6-9	1.21(1.56 \pm 0.12) 2.12	Rtsp
<i>Comphrena celosiooides</i> Mart.	13(16.26 \pm 0.27)	17.5	Pantoporate	0.56(0.55 \pm 2.25) 0.75	1.75(2.79 \pm 2.10) 2.25	Rt

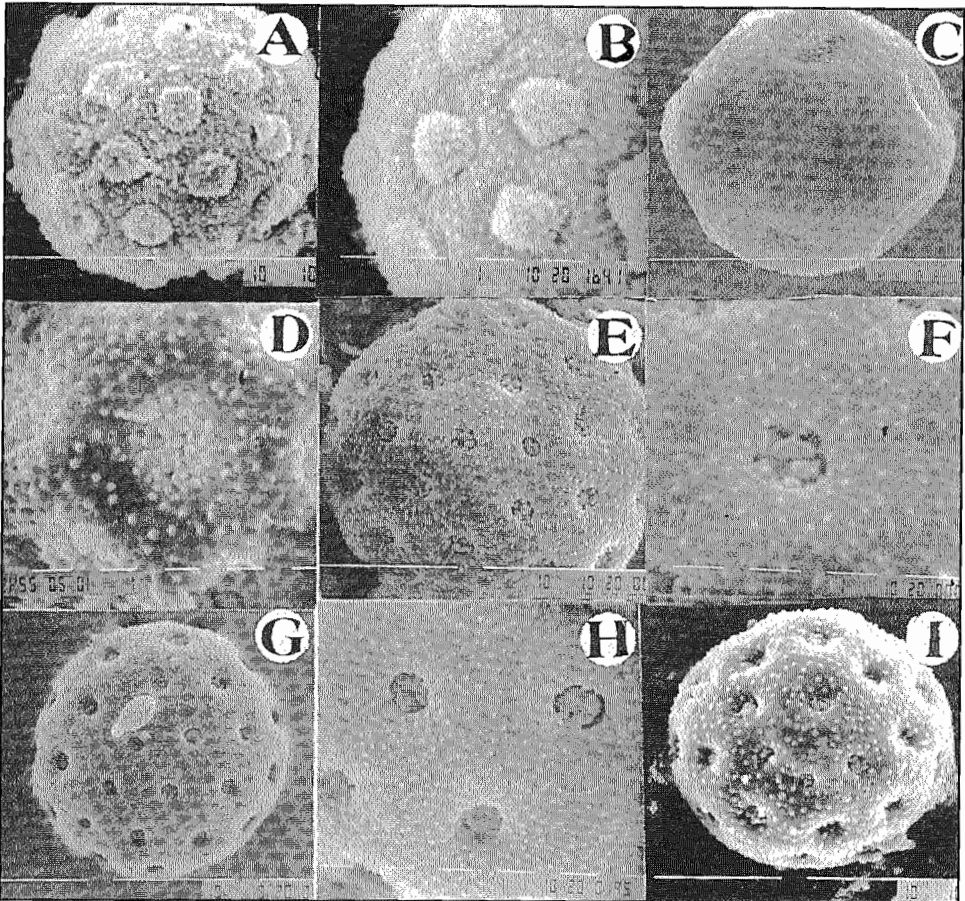


Fig.1. Scanning Electron micrographs of pollen grains. *Achyranthus aspera*: A, Pollen grain; B, Exine pattern, *Aerva pseudo-tomentosa*: C, Pollen grains; D, Exine pattern. *Amaranthus graecizans*: E, Pollen grain; F, Exine pattern. *A spinosus*: G, pollen grains; H, Exine pattern. *Digera muricata*: I, pollen grain.

Scale bar n= A, C, E, G & I = 10; B, D, F & H = 1 μ m

The terminology used is in accordance with Erdtman (1952); Faegri & Iversen (1964); Kremp (1965); Walker & Doyle (1976) and Moore & Webb (1978).

Observations

General pollen characters of the family *Amaranthaceae*

Pollen grains usually radially symmetrical, apolar, spheroidal, pantoporate, \pm circular, pores small or large, nonoperculate, or operculate, with rounded or star-like operculum, pore plate \pm scabrate – spinulose. Exine commonly very thick, baculate, undulated, sexine thicker or as thick as nexine. Tectum sparsely to densely scabrate, often spinulose.

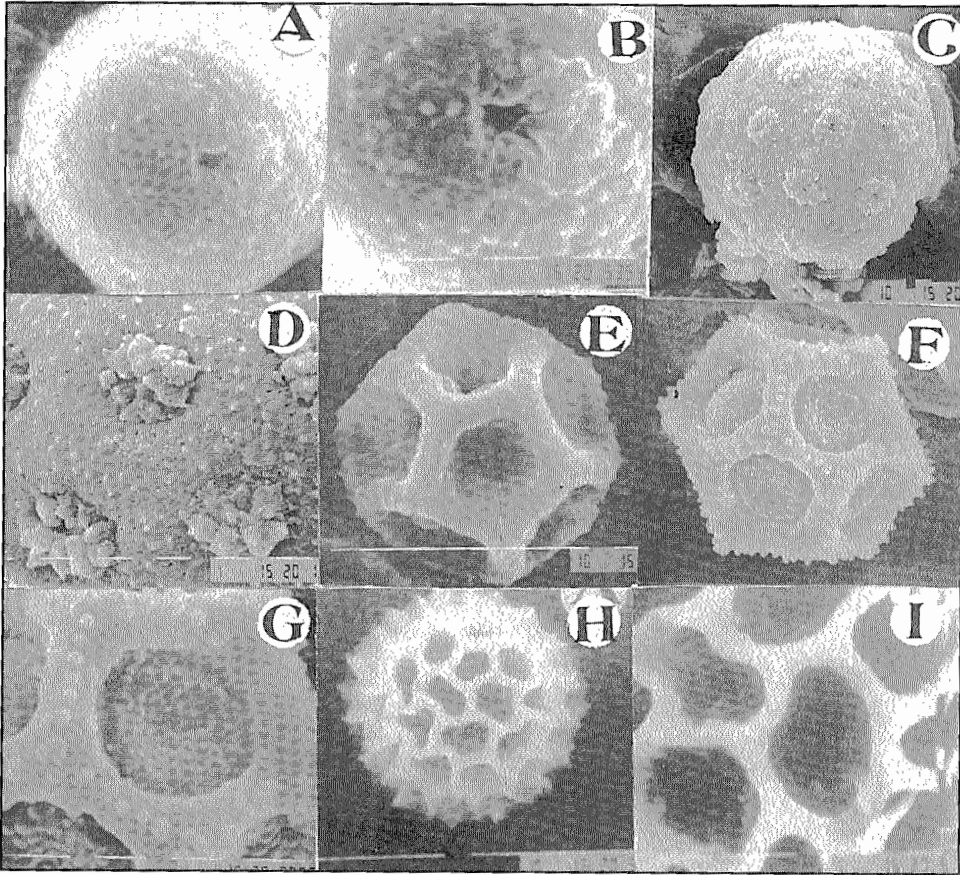


Fig.2. Scanning Electron micrographs of pollen grains. *Nothosaerva brachiata*: A, pollen grains; B, Exine pattern. *Pupalia lappacea*: C, Pollen grain; D, Exine pattern. *Alternanthera sessilis*: E, F, Pollen grain, G, Exine pattern. *Gomphrena celosioides*: H, pollen grains I, Exine pattern. Scale bar = A,C,E,F & H, = 10; B,D,G & I = 1 μ m

Pollen type - 1: *Amaranthus viridis* - type (Fig.1 A-1; Fig.2 A-D; Fig.3 A-D)

Pollen class: Pantoporate

P/E ratio: Adequate

Shape: Spheroidal

Apertures: Pori-small, circular with or with operculum.

Exine: Sexine thicker than nexine, or as thick as nexine.

Ornamentation: Tectum finely -densely scabrate.

Measurements: Size; (10-) 17.56 ± 0.27 (-25.13) μ m in diameter. Pore \pm circular, (0-75-) 2.94 ± 0.118 (-5.38) μ m in diameter, pore plate scabrate, sexine thicker than nexine. Exine (0.75-) 2.18 ± 0.05 (-3.61) μ m thick.

Species included:

Achyranthus aspera L., *A. bidentata* Blume, *Aerva pseudo-tomentosa* Blatt. & Hall., *A. lanata* (L.) Juss., *A. sanguinolenta* (L.) Blume, *Amaranthus graecizans* L., *A. hybridus* L., *A. tricolor* L., *A. spinosus* L., *A. viridus* L., *Celosia argentea* L. *Digera muricata* (L.) Mart., *Deeringia amaranthoides* (Lam.) Merr., *Nothosaerva brachiata* (L.) Wight, *Pupalia lappacea* (L.) Juss.

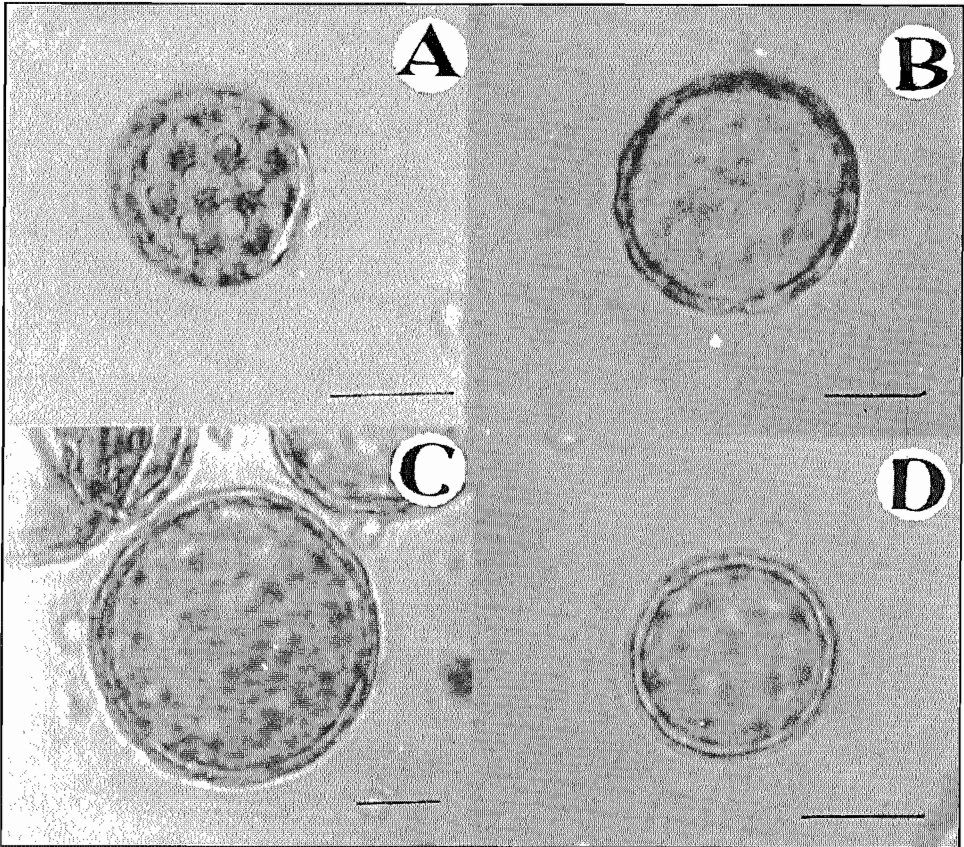


Fig.3. Light micrographs of pollen grains *Amaranthus graecizans*: A, Pollen grains; *Amaranthus hybridus*: B, Pollen grain. *A. spinosus*: C, Pollen grain. *Diagera muricata*: D, Pollen grain. Scale bar = 20 μm

Pollen type - II: *Gomphrena celosioides* - type (Fig.2 E-1)

Pollen class: 6-9-pantoporate

P/E ratio: Subtransverse.

Shape: Oblate-spheroidal.

Apertures: Pore - small, circular with or without operculum

Exine: Sexine thicker than nexine.

Ornamentation: Tectum reticulate

Measurements: Size: (11.25-) 14.34 ± 0.27 (-17.5) μm in diameter, (0.5-) 2.62 ± 0.243 (-4.75) μm in diameter. Pore plate scabrate. Exine (1.25-) 1.75 ± 0.105 (-2.25) μm thick.

Species included:

Alternanthera paronychioides St., *A. sessilis* L., *Gomphrena celosioides* Hil.

Discussion

Amaranthaceae is a stenopalynous family (Erdtman, 1952). It is fairly uniform in their pollen morphology. Pollen grains generally spheroidal, pantoporate with scabrate - punctate tectum. On the basis of exine patterns 2 distinct pollen types are recognized viz., *Amaranthus viridis* - type and *Gomphrena celosioides* - type.

Key to the species and species groups

1. + Pollen grains operculate 2
 - Pollen grains non operculate 3
2. + Operculum star like *Pupalia lappacea*
 - Operculum rounded (*Achyranthes aspera*, *A. bidentata*)
 *Achyranthes aspera* group
3. + Pores large 6-12 in number 4
 - Pores smaller >12 in number 5
4. + Diameter of pollen 10-11-11.54 μm *Nothosaera brachiata*
 - Diameter of pollen 13.02-17.51 μm *Deeringia amaranthoides*
5. + Pores 3.59-5.38 μm in diameter (*Aerva pseudotomentosa*, *A. lanata* and *A.*
 *sanguinolenta*) *Aerva lanata* – group
 - Pores 1.16-3.41 μm in diameter 6
6. + Pore plate densely scabrate 7
 - Pore plate sparsely scabrate 8
- 7 + Diameter of pollen 16-41-21.11 μm *A. viridus*
 - Diameter of pollen 25.19-30.51 μm *Digera muricata*
8. + Exine 1.41-1.54 μm thick *A. graecizans*
 - Exine 1.79-3.61 μm thick 9
9. + Pore c. 1.16 μm in diameter *A. hybridus*
 - Pore 1.79-3.41 μm in diameter 10
10. + Diameter of pollen 20.91-28.38 μm (*Amaranthus tricolor* and *A. spinosus*)
 *Amaranthus tricolor*-group
 - Diameter of pollen 13.51-17.51 μm *Celosia argenta*

Amaranthus viridus - type is readily distinguished by its scabrate-punctate tectum. Six genera viz., *Deeringia* R.Br., *Celosia* L., *Amaranthus* L., *Achyranthus* L., *Aerva* L. and *Nothosaerva* are included in this type. Pollen of *Achyranthes* L., and *Pupalia* L., have operculate pores. The pollen of the genus *Pupalia* (L.) Juss., (*Pupalia lappacea* (L.) Juss.) is characterized by star shaped operculum, whereas the species of the genus *Achyranthes* L., (*Achyranthes aspera* L.) have rounded scabrate operculum. In *Amaranthus* L., *Digera* Forssk., and *Aerva* L., non-operculated pores are found. In *Aerva* L., *Deeringia* R.Br., and *Nothosaerva* Wight, 6-12 porate grains are observed, while the remaining genera have 20-40 pores. On the basis of operculum, number of pore, pore diameter, pollen diameter and exine thickness, species of this pollen type are divided into 3 groups viz., *Achyranthus aspera* - group, *Aerva lanata* - group and *Amaranthus spinosus* - group and eight species i.e., *Amaranthus graecizans* L., *A. hybridus* L., *A. viridus* L., *Celosia argentea* L. *Digera muricata* (L.) Mart., *Deeringia amaranthoides* (Lam.) Merr., *Nothosaerva brachiata* (L.) Wight, *Pupalia lappacea* (L.) Juss. (See key to the species and the species groups).

Gomphrena celosioides - type is characterized by coarsely reticulate tectum, which includes *Gomphrena* L., and *Alternanthera* Forssk. However, in the genus *Alternanthera*

Forssk, 6-12 porate grains are present in which apertures cover the surface of the grains. Nowicke & Skvarla (1979) also reported similar type of grains in *Alternanthera* Wight, while in the genus *Gomphrena* L., small but numerous (20-30) spores are observed (Nowicke, 1975).

Nowicke & Skvarla (1979) also reported the fewer and large pores which cover the surface of the pollen grains in the subfamily Gomphernoideae.

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