



Pollen morphology of millets-exine surface ultrastructure

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ABSTRACT

Pollen morphology of 2 species belonging to the cultivated and wild varieties of millets i.e. *Pennisetum glaucum* & *Sorghum bicolor* of family Poaceae has been investigated using light microscope and scanning microscope. It is stenopalynous in nature. Pollen grain mostly spheroidal, monoporate, circular, pores small operculate, annulate. On the basis of apertural characters along with shape, size, surface, ornamentations of the exine, a comparative study of pollen grains is very useful in systematic consideration. The pollen grains of wild and some cultivated variety are found to be spheroidal, a single annulate, aperture with an operculum, brevicerebro orate exine ornamentation. Such pollen type will be the first report from Vidarbha (Maharashtra). These phenomena are the most important criteria for research dealing with both extant and extinct pollen grains.

KEY WORDS: Pollen, millet, Poaceae

INTRODUCTION

It is generally applicable to the cereal grains obtained from the members of family Poaceae. Rice, wheat, maize, sorghum, ragi, barley, pearl millets, fox-tail millet, rye, etc. come under this group. These form the principal sources of food for man and animals. Another term "millets" is generally used for the number of small grained cereals which are of minor importance as food. Sorghum and pearl millet forms another importance cereal of the tropical countries like India and Africa. Pearl millet is an annual plant which can be grown successfully on light-textured soils and under low soil moisture conditions. In India, it is mainly grown round the year under tropical Indian conditions.

Cereals and millets form the most important group of plants of family Poaceae. Poaceae is one of the largest and most widely distributed families of vascular plants and dominants of many ecosystems. A number of authors studied the pollen morphology of family Poaceae like [1-15]. Two pollen characters that have important values in systematic studies in grass are aperture types and exine surface patterns. However, the prevalence of a stenopalynous condition in grasses with one annulate aperture pollen grains, although providing a characteristic feature for Poaceae constitutes limiting factor when trying to distinguish the various taxa contained within the family.

The potential usefulness of the pollen exine features of the Poaceae as markers of gene expression and inheritance was shown mainly in intergeneric hybrids, where the influence of one or both parents on the exine sculpture of the resulted hybrids was recorded [16].

A study of the pollen morphology of cultivated grasses (*Zea mays*, *Sorghum vulgare* etc.) demonstrated that the size range curves are of immense taxonomic value in separating even the cultivars particularly when the number of taxa involved in the study is kept in the minimum. Rather, the above principle can be effectively used in solving taxonomic disputes at varietal levels.

The pollen grains of family Poaceae is Unipalynous (syn. Stenopalynous) being beset with an apertural apparatus consisting of a pore subtended by an annulus and capped by an operculum on the pore membrane. The study of SEM of some cereal grasses has shown the way for a possible separation of the different cereal grass species [6].

In the present study, two species of cultivated and wild varieties of Millets- (*Sorghum bicolor*, *Pennisetum glaucum*) of family Poaceae were examined by light and scanning electron microscope.

MATERIAL AND METHODS

The pollen sample of cultivated varieties of millets obtained from the Ankur seeds Pvt. Ltd. while the wild varieties of pearl millet and sorghum were collected from the ICRISAT. The pollen grains were prepared for light (LM) and scanning microscopy (SEM) by standard methods described by [17]. For light microscope the pollen grains were mounted in stained glycerin jelly and observations were made with simple microscope (10 & 40 x) using 10 x eye piece. For SEM studies dry pollen material were directly transferred to a metallic stub and coated with gold. Pollen size, pore and operculum diameter was measured. SEM studies were carried out at VNIT, Nagpur (India).

Following varieties were taken for the studies

Millets	Wild varieties	Cultivated varieties
a) <i>Sorghum bicolor</i>	i) IS-18830	i) MS-B-32 ii) GCP/SB/G-95 iii) GCP/SB/G 522
b) <i>Pennisetum glaucum</i>	i) IP- 21524 ii) IP- 21534	i) ABAC-6 ii) BS/R- 52 iii) CB-85

RESULTS AND DISCUSSION

General description of pollen grains: Pollen grains apolar, medium rarely large sized in diameter, spheroidal, monoporate, operculate to annulate or reduce annulus, generally sexine as thick as nexine often thicker or some time thinner than nexine.

Detailed observation of the pollen morphological feature, including size of grains, diameter of pore, width and height of annulus, exine surface patters are presented in table I. SEM study at X 1,500 magnification revealed distinct variations in pollen exine surface patterns of the cultivars in relation to the arrangement of the surface excrescences and different patterns of granules that are formed by the clustering of the surface excrescences, dividing the surface into small areas. The pollen size is equal to equatorial diameter since most grains are spheroidal. All other measurements were made on SEM-graphs. Terminology is used as per [18].

Exine patterns Brecevicerebro ornate which was first reported in *Eustachys tenera* type. The wild and cultivated varieties of *Sorghum bicolor* viz. IS-18830 & MS-B-32 and *Pennisetum glaucum* viz. IP-21524, IP-21534 & CB-85 also found with brecevicerebro ornate type exine pattern (Fig- 1 & 2-D; Fig-5&6-C; Fig-8-B), while other cultivated cultivars formed the areolate-cum-scabrate exine pattern (Fig-3& 4-C; Fig-9-B) and cultivated variety ABAC-6 shows areolate pattern (Figure-7B). The wild variety formed the average pore size -3.21 - 3.93 μm and annulus diameter are found to be 1.78 - 1.95 μm . While the cultivated variety of both the millets are found to be 2.60 μm - 4.37 μm and annulus diameter as 1.58 - 2.52 μm .

In this study, the wild variety of both species shows comparatively small pollen size, pore diameter than the cultivated type.

Distinct variation in this pollen feature among the cultivated and wild variety of *Pennisetum glaucum* and *Sorghum bicolor* is of significance especially in the context of homogeneity of Poaceae pollen grains, and thus may be considered as an additional parameter for use in cultivar taxonomy.

Name of the Cereals crops	Type	Pollen Size	Pore diameter (μm)	Annulus diamer (μm)	Exine Ornamentation
A) <i>Sorghum bicolor</i> I] Wild Var.- i) Is- 18830	1-porate annulate	124	3.21	1.95	Brevicerebro ornate
I] Cultivated Var. i) MS-B-32	1-porate annulate	144	4.12	2.52	Brevicerebro ornate
ii) GCP/SB/G-95	1-porate annulate	194	2.84	1.97	Areolate cum scabrate
iii) GCP/SB/G-522	1-porate annulate	158	3.99	2.08	Areolate cum scabrate

B) <i>Pennisetum glaucum</i> I] wild var. i) IP-21524	1-porate annulate	177	3.93	1.78	Brevicerebro ornate
ii) IP-21534	1-porate annulate	173	3.87	1.78	Brevicerebro ornate
II] Cultivated Var.-i) ABAC-6	1-porate annulate	196	2.60	1.58	Areolate
ii) CB-85	1-porate annulate	133	4.37	2.19	Brevicerebro ornate
iii) BS/R-52	1-porate annulate	168	3.75	1.97	Areolate cum scabrate

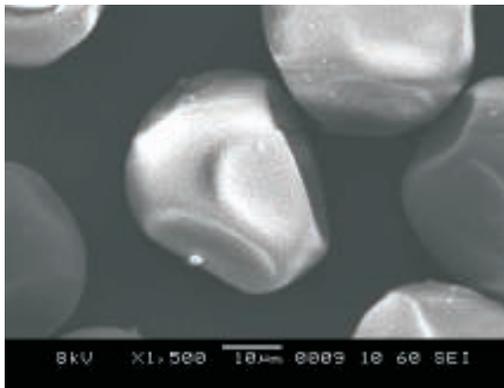
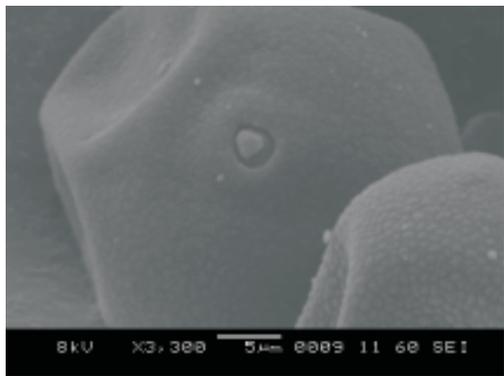


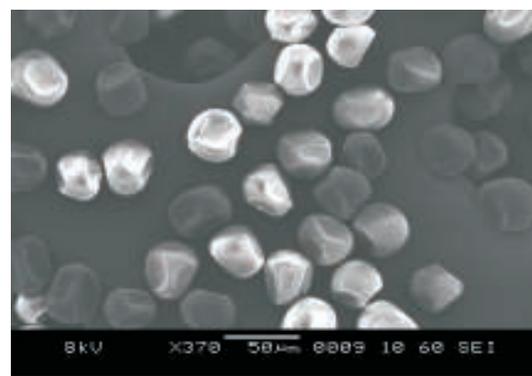
Fig – 1 A]



B]



C]



D]

Fig-1 Wild cultivar of Sorghum (A-D) – IS – 18830 A) Scanning electron micrograph of pollen grains; B) grain spheroidal, subpolar view; C&D) Part of the pollen grains showing operculate-annulate pore, Brevicerebro ornate exine pattern with pore size measurement. Scale bars – A) 50 µm, B) 10 µm.

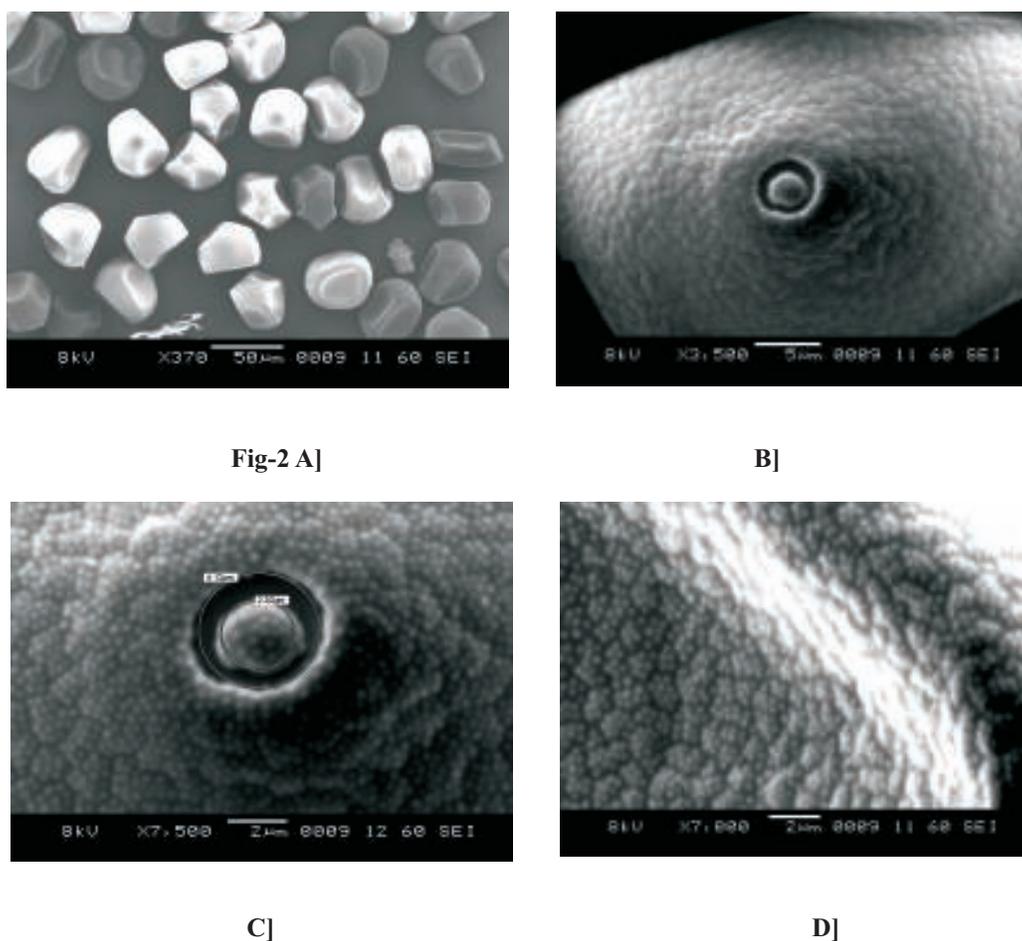


Fig-2(A-D); A) Scanning electron micrograph of pollen grains; B&C) Part of the pollen grains showing operculate-annulate pore; D) Brevicerebro ornate exine pattern, Scale bar- A) 50 um, C & D) 2 um

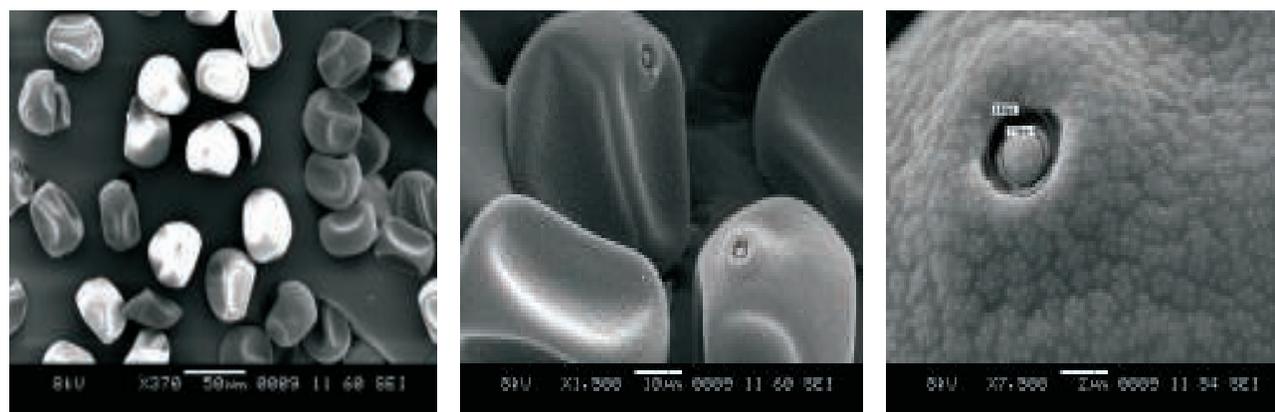


Fig-3 (A-C); A) Scanning electron micrograph of pollen grains; B) Spheroidal, subpolar view; C) details of an operculate-annulate aperture, showing Areolate-cum-scabrate exine pattern.

Fig-4 A] **B]** **C]**
Fig-4 (A-C); A) Scanning electron micrograph of pollen grains; B) pollen grain spheroidal, subpolar view; C) operculate-annulate aperture Areolate-cum-scabrate exine pattern.



Fig-5 A] **B]** **C]**
Fig-5 & 6 (A-C); A) Scanning electron micrograph of pollen grains; B) grain spheroidal, subpolar view; C] details of an operculate-annulate aperture, Brevicerebro ornate exine pattern
Scale bar- fig 3,4 & 5 - A) 50 um, B)10 um,C) 2um

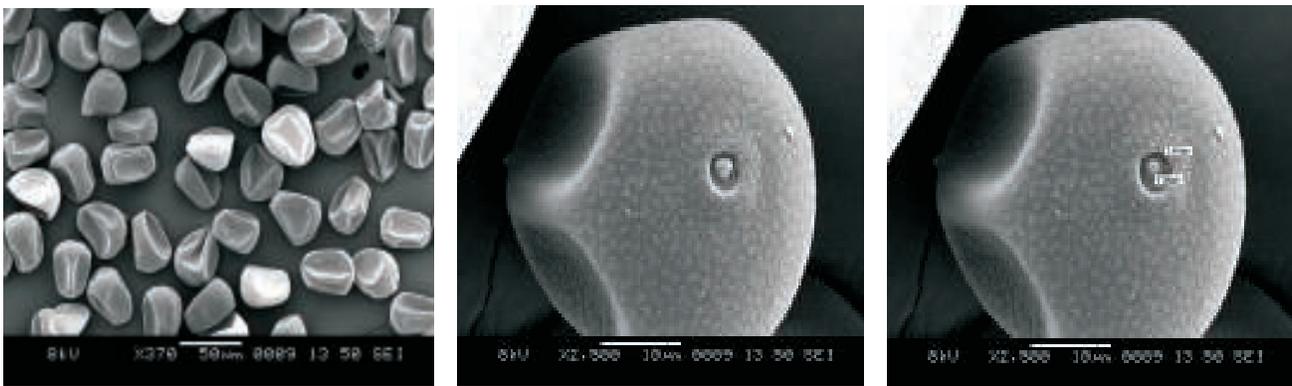
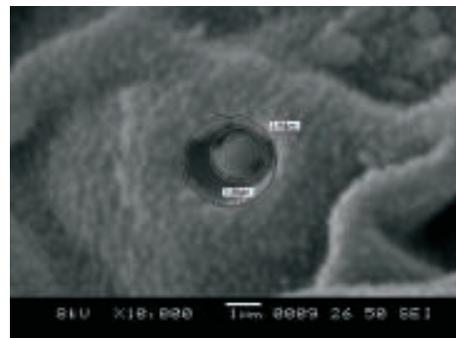


Fig-6 A] **B]** **C]**



Fig-7 A]



B]

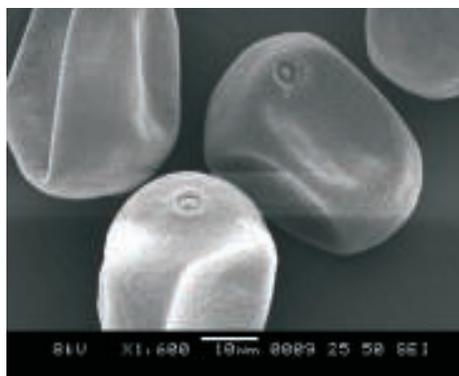
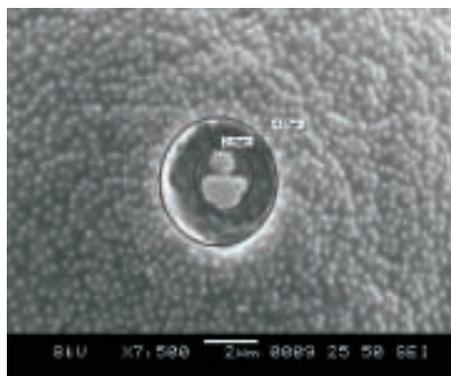


Fig-8 A]



B]

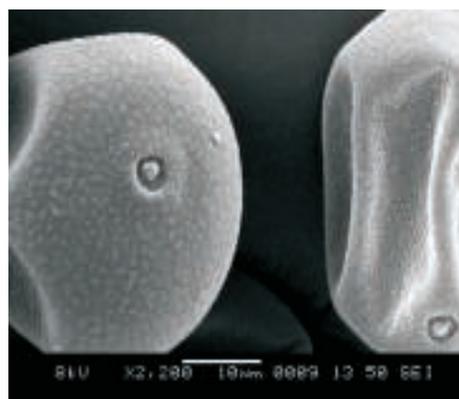
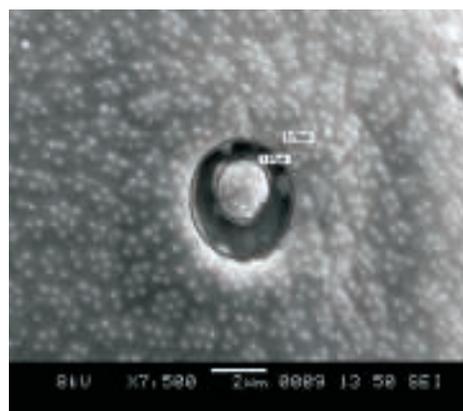


Fig-9 A]



B]

Fig-7, 8 &9(A-B); A) Scanning electron micrograph of pollen grains fig-7- B) pollen show areolate exine pattern; fig-8 B) operculate-annulate aperture, Brevicerebro ornate exine pattern; fig-9 B) operculate-annulate aperture showing areolate-cum-scabrate Scale bar- A) 10 um B) 2um

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