

Pollen morphological studies on some members of the family Nyctaginaceae in India

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ABSTRACT

The pollen morphology of twelve species belonging to five genera, i.e. Mirabilis L., Boerhavia L., Commicarpus Standl., Bougainvillea Comm. ex Juss. and Pisonia L. of the family Nyctaginaceae was studied by Light microscope and Scanning electron microscope. The family is eurypalynous, having pollen grains of varying shapes, sizes and aperture pattern. The pollen morphology of the taxa studied can be correlated with the varied habit of the members of the family.

Key words: Nyctaginaceae, pollen morphology, India

INTRODUCTION

The family Nyctaginaceae, commonly known as 4 o'clock family, comprises c. 27 genera and 350 species in the world, is distributed in tropical and subtropical parts of both the hemispheres [1]. In India, the family is represented by 6 genera and 14 species.

The family is taxonomically complicated in terms of its classification, differential placement and phylogeny which has drawn attention of the taxonomists since long. Accordingly the family has been classified with number of tribes, sub-tribes, genera and infra-generic taxa from time to time aiming to solve inter- and intra- familial relationship [2-8].

Pollen morphological characters, as a useful tool in better understanding of the taxonomic disputes and classification of plants, have been critically employed in several angiosperm families since decades. Pollen grains of the family Nyctaginaceae have been studied by different authors time to time [9-22].

MATERIALS AND METHODS

The present study is based on polliniferous materials procured from field collection as well as duplicate herbarium specimens deposited in different Indian herbaria. The pollen grains were prepared for light (LM) and scanning electron microscopy (SEM) by the standard acetolysis methods [23]. For light microscopy, the pollen grains were mounted in unstained glycerin jelly and observations were made by Olympus light microscope, Model CX41 with 1.3 apochromatic objectives (X 40 X / 0.65) and [X 100 X / 1.25 (oil)]; eye piece (X 10 X). For SEM studies, pollen grains were suspended in a drop of water and directly transferred with a fine pipette to a metallic stub using double-sided adhesive tape and coated with gold in a sputtering chamber. The specimen stubs were then observed under the Scanning Electron Microscope (SEM – Model No. Hitachi S – 530) maintaining accelerating voltage of 25 kv. The samples were viewed, studied and finally photomicrographs were taken at different magnifications. The SEM study was carried out in Instrumentation Department of the University of Burdwan, Burdwan, West Bengal and at Central

National Herbarium, Botanical Survey of India (CAL). The characters of palynomorphs were described in terms of shape, size, aperture type, details of aperture and pattern of exine ornamentation. Standard terminologies of pollen grains were followed [9, 24].

However, due to paucity of the specimens, twelve (12) species under five (05) genera were considered for palynological study.

RESULTS AND DISCUSSION

General pollen characters of the family Nyctaginaceae:

The family Nyctaginaceae is eurypalynous. The pollen grains are spheroidal, oblate-spheroidal to oblate in shape and the size ranges from 22-210 μm diam. Apertures are varied, ranging from pantoporate, 3-colpate, 3-4-6-colpate or pantocolpate condition. The exine is thick, spinulose or reticulate and when spinulose, spines are variable in size and shape with distinct base. The sexine is usually thicker than the nexine. Details of the palynological observations of the studied taxa for the present work are given in **Table 1, Plate1**.

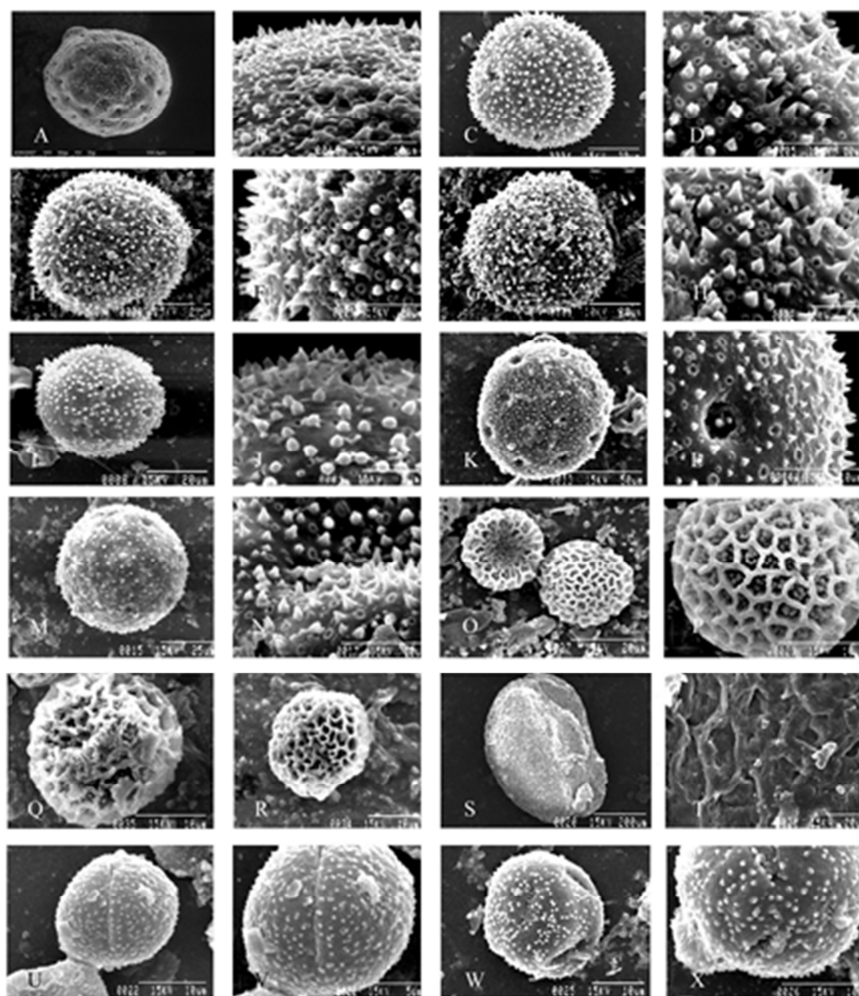


Plate 1. SEM photograph of pollen grains of some members of the family Nyctaginaceae.

A.-B. *Mirabilis jalapa* L.; C.-D. *Boerhavia crispera* Heyne ex Hook. f.; E.-F. *Boerhavia diffusa* L.; G.-H. *Boerhavia erecta* L.; I.-J. *Boerhavia rubicunda* Steud.; K.-L. *Commicarpus chinensis* (L.) Heimerl; M.-N. *Commicarpus verticillatus* (Poir.) Standl.; O.-P. *Bougainvillea glabra* Choisy; Q.-R. *Bougainvillea spectabilis* Willd.; S.-T. *Pisonia aculeata* L.; U.-V. *Pisonia grandis* R.Br.; W.-X. *Pisonia umbellifera* (Forst.) Seem.

Table 1: Salient pollen morphological characters of the studied species of different genera of Nyctaginaceae

Name of the taxa	Shape	Diam.	P x E	Exine		Aperture				Remarks
				Thickness	Ornamentation	Type	No.	Diam.	Membrane	
<i>Mirabilis jalapa L.</i>	Spheroidal, oblate-spheroidal	125-140 µm		10-15 µm	Spinulose; spinules 0.5-1 µm high, randomly distributed	Pantoporare	18-20	6.3-10 µm	Margin ornate, membrane provided with spinulose and granulose	Some abnormal joint and giant pollen grains observed
<i>Boerhavia crista Heyne ex Hook.f.</i>	Spheroidal	42-47 µm		± 4.25 µm	Spinulose; spines 2.5-3 µm high, apex acute	Pantoporare	± 24	± 6 µm		Sexine = Nexine
<i>B. diffusa L.</i>	Spheroidal	55-60 µm		5 µm	Spinulose; spines 2.5-3 µm high, apex acute	Pantoporare	24-28	3.5-4 µm		Nexine > Sexine, Sexine 2 µm, nexine 3 µm
<i>B. erecta L.</i>	Spheroidal	57-60 µm		9 µm	Spinulose; spinules 0.5-3 µm high, apex blunt	Pantoporare	20-22	± 4 µm		Nexine > Sexine, Sexine 4 µm, nexine 5 µm, mixed types of spinules 0.5-3µm
<i>B. rubicunda Steud.</i>	Spheroidal	±45 µm (42.5 µm – 55 µm)		4.5-7 µm	Spinulose; spines 1.15-2.3 µm high, apex blunt	Pantoporare	18-20	6.3-10 µm		Spines club-shaped with blunt tip and sparsely distributed
<i>Commicarpus chinensis (L.) Heimerl</i>	Spheroidal	75-80 µm		5.5 µm	Spinulose	Pantoporare, operculate	24-30	± 5.25 µm	Operculate	Spines base tapered, apex acute, sparsely distributed. Sexine > Nexine
<i>Commicarpus verticillatus (Poir.) Standl.</i>	Spheroidal	62-66 µm		± 5.5 µm	Microreticulate and spinulose	Pantoporare	22-24	4.5-5 µm	Operculate	Spines base tapered, apex acute, sparsely distributed
<i>Bougainvillea glabra Choisy</i>	Spheroidal	24-30 µm		3.5-5 µm	Reticulate; lumina 3-4.25 µm; muri 1.5-2 µm thick; homobrochate	Tri-colpate	3			Lumina provided with 4-9 free columella; lumina linear near the aperture
<i>B. spectabilis Willd.</i>	Spheroidal	35-40 µm		4.5 µm	Reticulate; heterobrochate	Tri-colpate	3			Lumina provided with free columella
<i>Pisonia aculeata L.</i>	Prolate-spheroidal		40-45 x 35-41 µm	3.5-4 µm	Microreticulate; lumina < 1 µm	Tri-colpate	3		Smooth	Colpa slit like extending up to poles. Sexine = Nexine
<i>P. grandis R. Br.</i>	Suboblate-spheroidal		26-35 x 30-40 µm	±4 µm	Spinulate; spinules 0.5-0.75 µm high	Tri-colpate	3	± 5.25 µm	Granulate	Spinules sparsely distributed, apex acute
<i>P. umbellifera (Forst.) Seem.</i>	Oblate-spheroidal		45-50 x 51-56 µm	205-3 µm	Spinulose; spinules 0.5 µm or less	8-colpate - polycolpate	8 to many	4.5-5 µm	Colpus membrane granulate	Colpa 15-18 µm length. Sexine = Nexine

***Mirabilis* L.**

***Mirabilis Jalapa* L.:** Pollen grains spheroidal, 125-140 μm diam. (smaller ones 70-85 μm diam.), pantoporate; pores 95-112, circular, ± 5 μm diam., margin ornate, membrane provided with spinules and granules. Exine 10-15 μm thick, spinulose; spines 0.5-1 μm high, randomly distributed, punctitectate; sexine equals to nexine. Pollen dimorphism is frequently found in this species (white-pink, mixed and mixed radiated); occasional giant, dimorphic anomalous, deformed and joint grains have been observed. All these anomalous pollen grains except giant pollen grains are sterile.

***Boerhavia* L.**

***Boerhavia crispera* Heyne ex Hook. f.:** Pollen grains spheroidal, 42-47 μm diam.; pantoporate; pores ± 24 , circular, ± 6 μm diam. Exine ± 4.25 μm thick, spinulose; spines 2.5-3.5 μm high, apex acute; sexine equals to nexine.

***Boerhavia diffusa* L.:** Pollen grains spheroidal, 55-60 μm diam.; pantoporate; pores 24-28, circular, 3.5-4 μm diam. Exine about 5 μm thick, spinulose; spines 2.5-3 μm high, apex acute; nexine greater than sexine.

***Boerhavia erecta* L.:** Pollen grains spheroidal, 57-60 μm diam.; pantoporate; pores 20-22, circular, ± 4 μm diam. Exine about 9 μm thick, spinulose; spines 0.5-3 μm high, apex blunt; nexine greater than sexine.

***Boerhavia rubicunda* Steud.:** Pollen grains spheroidal, 42.5-55 μm diam.; pantoporate; pores 18-20, circular, 6.3-10 μm diam. Exine 4.5-7 μm thick, spinulose; spines club-shaped with blunt tip, sparsely distributed, 1.15-2.3 μm high.

***Commicarpus* Standl.**

***Commicarpus chinensis* (L.) Heimerl:** Pollen grains spheroidal, 75-80 μm diam., pantoporate; pore operculate, 24-30, ± 5.25 μm diam. Exine about 5.5 μm thick, micro-reticulate and spinulose; spines sparsely distributed, base tapered, apex acute; lumina < 1 μm ; muri comparatively thick, ± 1 μm thick; sexine greater than nexine.

***Commicarpus verticillatus* (Poir.) Standl.:** Pollen grains spheroidal, 62-66 μm diam., pantoporate; pore 22-24, 4.5-5 μm diam., operculate. Exine ± 5.5 μm thick, micro-reticulate and spinulose; spines sparsely distributed, base tapered, apex acute; lumina ± 1 μm ; muri ± 1 μm thick; sexine greater than nexine

***Bougainvillea* Comm. ex Juss.**

***Bougainvillea glabra* Choisy:** Pollen grains spheroidal to oblate-spheroidal, 24-30 μm diam., 28-30 μm x 32-35 μm , 3-colpate; colpus short, tapering. Exine 3.5-5 μm thick, reticulate, homobrochate; lumina 3-4.25 μm ; muri 1.5-2 μm thick; some free collumellae observed in the lumi; lumina linear near the aperture; sexine greater than nexine.

***Bougainvillea spectabilis* Willd.:** Pollen grains spheroidal to oblate-spheroidal, 35-40 μm diam., 37-40 μm x 46-50 μm , 3-colpate; colpus short, tapering. Exine thick, about 4.5 μm , reticulate, heterobrochate; lumina smaller around colpus; big lumina provided with free columellae; sexine greater than nexine.

***Pisonia* L.**

***Pisonia aculeata* L.:** Pollen grains prolate-spheroidal, P x E = 40-45 μm x 35-41 μm , 3-colpate, colpus long slit like, extending up to poles. Exine 3.5-4 μm thick, micro-reticulate; lumina < 1 μm ; muri > 1 μm ; exine thicker at poles; sexine equals to nexine.

***Pisonia grandis* R. Br.:** Pollen grains sub-oblate-spheroidal, P x E = 26-35 μm x 30-40 μm , 3-6-colpate, mostly 3-colpate. Exine 2.5-3 μm thick, spinulose; spinules < 1 μm , mostly 0.5-0.75 μm , sparsely distributed, apex acute; sexine equals to nexine.

***Pisonia umbellifera* (Forst.) Seem.:** Pollen grains oblate-spheroidal, P x E = 45-50 μm x 51-56 μm , 8-colpate to polycolpate; colpus slit like, 15-18 μm . Exine 2.5-3 μm thick, spinulose; spinules ± 0.5 μm , sparsely distributed; sexine equals to nexine.

CONCLUSION

Pollen morphology of the taxa of the family Nyctaginaceae, studied for the present work is extremely varied which can be correlated with the varied habit of the plants belonging to this family. It is apparent from the present observation that the herbaceous genera like *Boerhavia* L., *Commicarpus* Standl. and *Mirabilis* L. are characterized by spheroidal, pantoporate and spinulose pollen grains. The shrubby taxa like *Bougainvillea* Comm. ex Juss. are characterized by spheroidal, 3-colpate and reticulate type of pollen grains and more interestingly the woody and

lofty three species of *Pisonia* L. are characterized by oblate-spheroidal to prolate-spheroidal pollen grains having 3-6-poly colpate apertures, with either mono-reticulate or spinulose exine ornamentation.

These interesting characters can be correlated with other biosystematical characters like cytology, anatomy, leaf architecture, etc. for better understanding of the intra- and inter-relationship of the taxa and phylogeny of the family. It is apparent from the general pollen characters of species studied that the herbaceous members are very much related to the Chenopodiaceous and Phytolaccaceous members but the *Pisonia* L., the lofty tree species up to 100 ft height (34 m) included in the family is apparently aberrant and misfit in the family palynologically.

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