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Palynomorphological Diversity Among The Species Belong To 12 Genera of Malvaceae *Sensu lato*

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ABSTRACT

Malvaceae *sensu lato (s.l.)* is a heterogeneous family rich in highly diversified characters among its taxa, since phylogenetic studies on Malvaceae *sensu lato* lead to merger of core families of Malvales, i.e. Sterculiaceae, Tiliaceae, Bombacaceae and Malvaceae *s.s.* into its fold and distribution of their genera among nine subfamilies: Bombacoideae, Brownlowioideae, Byttnerioideae, Dombeyoideae, Grewioideae, Helicteroideae, Malvoideae, Sterculioideae, and Tilioideae[1,2]. While understanding its taxonomical relationships and affinities, it is important to identify palynomorphology to delimit the taxa. In this study, pollen morphology of common species of this family belong to Chityal Reserve Forest area, Nalgonda district, Telangana is discussed. Pollen morphological characters of these species range from spheroidal to prolate, echinate and reticulate to scabrate to granulate, pantoporate to colporate to trizonoporate etc., which reflect the diversity among the taxa. This study is based on pollen morphological variations among the common species, each belong to 12 different genera with a key for their simple identification.

KEY WORDS: Malvaceae *s .l*, Palynomorphology, Chityal RF.

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INTRODUCTION

The traditional **Malvaceae *sensu stricto (s.s.)*** contained a homogeneous and monophyletic group. Based on number of morphological and molecular data, **Malvaceae *sensu lato (s.l.)***, is recently defined in **APG III**[2], in which closely related families belong to core Malvales, i.e. **Sterculiaceae, Tiliaceae, Bombacaceae** and **Malvaceae** have been merged into its fold making it an expanded heterogeneous family. According to APG III Classification, **Malvaceae *s.l.*** contains nine subfamilies: **Bombacoideae** (formerly Bombacaceae, in part), **Brownlowioideae, Byttnerioideae, Dombeyoideae, Grewioideae, Helicteroideae, Malvoideae** (formerly Malvaceae), **Sterculioideae** (formerly Sterculiaceae, in part), and **Tilioideae** (formerly Tiliaceae, in part)[1,3]. The genera formerly belong to Sterculiaceae are now distributed among subfamilies, **Byttnerioideae, Helicteroideae, Sterculioideae** and **Dombeyoideae** in the newly formed family **Malvaceae *s.l.***. Most of the genera belong to Tiliaceae are included in **Brownlowioideae** and **Grewioideae** and the remaining in **Tilioideae**[3].

Palynological information is frequently used in the taxonomy and phylogeny of several taxa[4-6], other than in aero- palynology and mellitopalynology etc. Pollen morphology of Malvaceae *s.s.* was earlier described by El Naggar[6], Christensen[7], Culhane and Blackmore[8], A.Perveen[9] and other related families by Saad[10], N.E. Hussaini[11], A.Perveen[12,13] etc. In India, pollen morphological studies particularly on Malvaceae was done by Nair PKK[14-16] , Nayar TS[17], and DS Reddy[18] etc. Lakshmi KG[19] worked on south Indian Malvales for her doctoral thesis. In the context of **APGIII**, Palynomorphological diversity among the different genera of **Malvaceae *s.l.*** belonging to Nalgonda district of Telangana is described here.

Geographical information

Chityal Reserve Forest (RF) is located in Nalgonda District at a Latitude-17^{o}, Longitude-79.2^{o} (Figure 1), consists of dry deciduous and thorny Scrub vegetation over the hill ranges, which is a common feature of the general Deccan landscape.

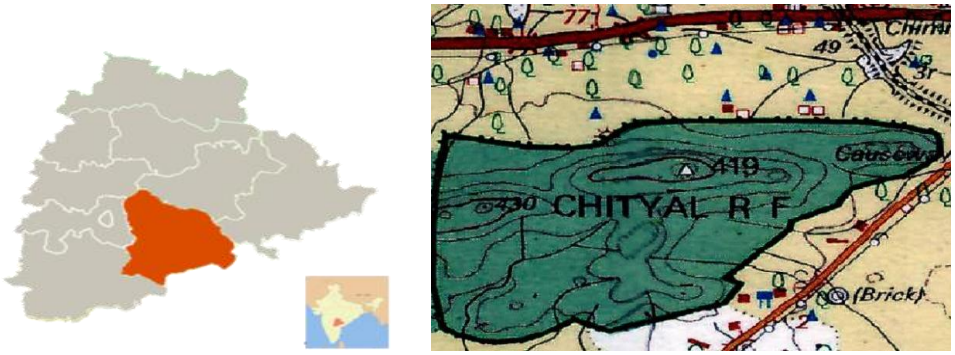

Figure 1: Chityal R.F. of Nalgonda district- geographical map

(Courtesy of Dist.Forest Office, Nalgonda with permission)

METHODOLOGY

Fresh polleniferous material was collected from Chityal Reserve Forest area of Nalgonda Dist., Telangana, India. Specimens were preserved in the form of herbaria and identified with the help of standard keys and Botanical Survey of India, Hyderabad. Pollen was acetolysed as per the modified procedure of Erdtman[21-23] and Nair PKK[24] and mounted by glycerine jelly on glass slides. The prepared slides were observed under a light microscope (Olympus CH20i). Pollen shape, Aperture morphology and sculpturing etc., were digitally recorded based on observation of 10 - 50 grains.

RESULTS

Table 1: Pollen morphological characters of species belong to different genera of Malvaceae (P=polar length, E=equatorial diameter).

S.No.	Sub family	Scientific name	Pollen diameter (µm)	P (µm)	E (µm)	Pollen shape	Aperture morphology	Exine sculpturing
1	Byttnerioideae	***Waltheria indica* L.**		32-35	35-39	Oblate - spheroidal	4-5 zonocolporate	Reticulate
2	Dombeyoideae	***Melhania incana* Heyne ex Wight&Arn.**		54-60	64-69	Oblate-spheroidal	Triporate	Echinate, reticulate
3	Grewioideae	***Corchorus aestuans* L.**		30-36	20-27	Prolate	Trizonocolporate	Reticulate, perforate
4	Malvoideae	***Abelmoschus esculentus* (L.)Moench.**	135-160			Spheroidal	Pantoporate	Echinate
5	Malvoideae	***Abutilon indicum* (L.)Sweet**		45-60	57-63	Oblate-spheroidal	Trizonocolporate	Echinate
6	Malvoideae	***Gossypium hirsutum* L.**	75-86			Spheroidal	6-7 zonoporate	Echinate
7	Malvoideae	***Hibiscus rosa-sinensis* L.**	100-135			Spheroidal	Pantoporate	Echinate
8	Malvoideae	***Malvastrum coromandalianum* (L.)**	45-65			Spheroidal	Pantoporate	Echinate
9	Malvoideae	***Pavonia odorata* Willd.**	70-90			Spheroidal	Pantoporate	Echinate

10	Malvoideae	***Sida ovata* Burm.**	50-70			Spheroidal	Pantoporate	Echinate
11	Malvoideae	***Thespesia populnea* (L.)Sol.ex Corr.**	70-81			Spheroidal	Pantoporate	Echinate
12	Helicteroideae	***Helicteres isora L.***		12-15	19-25	Oblate	Trizonoporate	Baculate

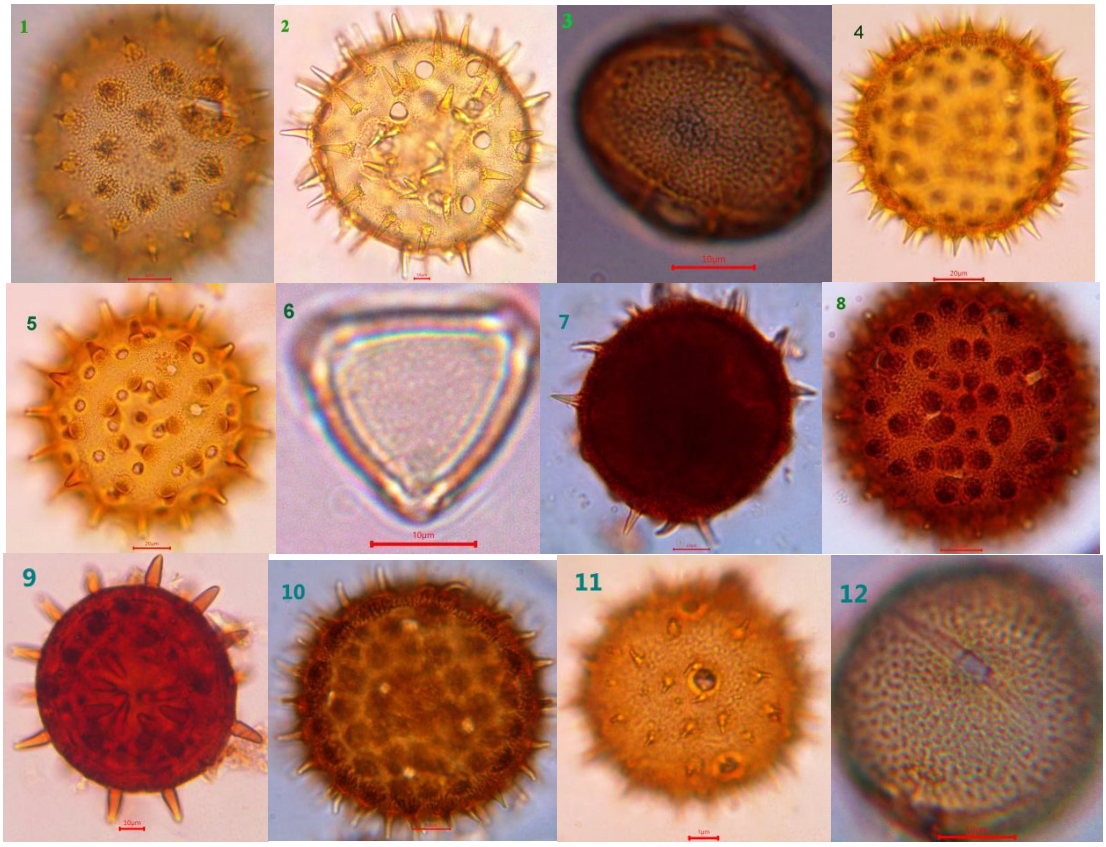

Fig:2. Pollen morphology of 1.*Abutilon indicum*(1000x) 2. *Abelmoschus esculentus*(1000x) 3. *Corchorus aestuans*(1000x) 4. *Gossypium hirsutum* (400x) 5. *Hibiscus rosa-sinensis* (400x) 6. *Helicteres isora* (1000x) 7. *Melhania incana* (1000x) 8. *Malvastrum coromandalianum* (1000x) 9. *Pavonia odorata*(400x) 10. *Sida ovata*(1000x) 11. *Thespesia populnea*(1000x) 12. *Waltheria indica* (1000x). Scale bars: 10 µm in all.

Pollen identification key

I. Echinate (+) and shape spheroidal to oblate spheroidal

Ia. Basal cushion (+)

1. 3-zonocolporate -*Abutilon indicum*
2. 6, 7-zonoporate -*Gossypium hirsutum*
3. Pantocolporate
   - i. Basal cushions distant -*Sida ovata*
   - ii.Broad basal cushions arranged closely, short and acute spines -*Malvastrum coramandalianum*
4. Pantoporate - *Thespesia populnea*

Ib. Basal cushion (-)

5. 3-zonoporate, spines dimorphic and surface reticulate -*Melhania incana*

6. Pantoporate

6i. grain size > 100 µm spine tips acute

a. spine length 10-15µm, grain size 100-135 µm, pore diameter <7 µm

- *Hibiscus rosa-sinensis*

b. spine length 15-18 µm, pore diameter >7 µm, grain size 135-160 µm

-*Abelmoshcus esculentus*

6ii. grain size < 100 µm, spines columnar, tips blunt

-*Pavonia odorata*

II. Echinate (-)

II a. Oblate to oblate-spheroidal

7. 3-zonoporate, oblate, exine surface papillate -*Helictores isora*

8. 4, 5-zonocolporate, oblate- spheroidal -*Waltheria indica*

II b. Prolate to subprolate

9. 3-zonocolporate, faintly reticulate -*Corchorus aestuans*

DISCUSSION

Several studies were conducted on the pollen morphology of Malvaceae ***s.s.***. Christensen[7] extensively investigated 120 species belong to 40 genera of Malvaceae ***s.s.***. Anjum Purveen[9] elaborately studied ***Abutilon***, ***Sida***, ***Abelmoschus***, ***Senra***, ***Malva*** and ***Hibiscus*** pollen types of Malvaceae, ***Corchorus, Grewia*** and ***Triumfetta*** species of subfamily Grewioideae[12] and two ***Melhania*** species of subfamily Dombeyoideae[13] from Pakistan. 21 species of Egyptian Malvaceae were investigated by El Naggar[6]. Grewia, Hermannia and Melhania types were studied by NE Husseini[11].

Malvaceae *s.l.* pollen is eurypalynous with wide range of morphological diversity from spheroidal to oblate to prolate shapes, aperture number and character from 3-zonoporate(***Helicteres isora)*** to pantoporate and exine surface from granulate/scabrate(***Abutilon indicum)*** to reticulate (***Waltheria indica*** and ***Corchorus aestuans)*** to papillate/baculate (***Helictores isora)***(table 1). Pollen morphological diversity of the family is useful in the identification of different genera in palynotaxonomic, aeropalynological and mellitopalynological studies. Species belong to Malvoideae and Dombeyoideae subfamilies have echinate pollen, whereas species belong to remaining subfamilies have non echinate pollen. Except the pollen of the species belong to Grewioideae subfamily (previously belong to Sterculiaceae and Tiliaceae) where the pollen is prolate to subprolate, pollen of the remaining subfamilies in major cases spheroidal to oblate-spheroidal to sub-oblate. Presence or absence of the basal cushion is the main criteria in distinguishing the species

belong to different genera of Malvoideae subfamily. In this subfamily, pollen of species belong to genera ***Abutilon, Gossypium*** and ***Sida*** can be identified based on the presence of basal cushion and those belong to genera ***Abelmoschus***, ***Hibiscus*** (Fig.2) without basal cushion. According to evolutionary studies porate form is evolved from colporate and colpate and increase in the number of pores (pantoporate) is an advanced character as against primitive monoporate/sulcate form in Monocots[24,25]. Aperture morphology usually 3-zonocolporate to pantoporate in Malvoideae and Dombeyoideae, in other subfamilies it ranges from 3,4-zonocolporate to 3-zonoporate. Based on aperture evolution species of Malvoideae subfamily with pantoporate pollen can be considered as highly evolved. Pollen of species belonging to the genera of **Grewiodeae**, **Sterculioideae** and **Dombeyoideae** subfamilies is tricolporate and exine surface is reticulate. In ***Melhania incana,*** pollen is dimorphic with both curved and erect spines. Among the 12 genera, spines of the pollen of ***Abelmoshcus esculentus*** are the longest.

CONCLUSION

Malvaceae *s.l.* is eurypalynous with diversified taxa. In the context of APG III, it is necessary to discuss pollen morphological variations and affinities among the taxa at genera/ subfamily level. Here the palynomorphological diversity among the 12 genera belong to various subfamilies is discussed. Diversity in pollen morphology is evident based on the presence or absence of the spines, spine length/number, size and shape of the pollen, aperture shape/size and number and tectum ornamentation. It is useful in delimitation of taxa and affinities among the subfamilies/genera in the view of linking with their evolutionary origin.

REFERENCES

1. Bayer, C., M.F. Fay, A.Y. De Bruijn, V. Salvolainen, C.M. Morton, K. Kubitzki, W.S. Alverson and M.W. Chase, Support for an expanded family concept of Malvaceae within a recircumscribed order Malvales: a combined analysis of plastid *atp*B and *rbc*L DNA sequences. *Bot. J. Linni Soc.*, 1999; **129**: 267–303.
2. Angiosperm Phylogeny Group, "An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III", Botanical Journal of the Linnean Society, 2009; **161** (2): 105–121.
3. Bayer & Kubitzki, K. *Malvaceae* Pp. 225-311 in: Kubitzki, ed., The families and genera of vascular plants, 2003; **5**.
4. Ferguson, I. K., Observations on the variation in pollen morphology of *Palmae* and its significance. Can. J. Bot., 1986; **64**: 3079-3090.

5. Hilsenbeck, R. A., Pollen morphology and systematics of *Siphonoglossa* sensu lato (*Acanthaceae*). – Amer. J. Bot., 1990; **77**(1): 27-40.
6. El Naggar, S.M., Pollen morphology of Egyptian Malvaceae: An assessment of taxonomic value. *Turk. J. Bot*., 2004; **28**: 227-240.
7. Christensen, P.B., Pollen morphological studies in the Malvaceae. *Grana*, 1986; **25**: 95-117.
8. Culhane, K.J. and S. Blackmore, Malvaceae, In: *The NorthWest European Pollen Flora*,(Eds.): W. Punt, S. Blackmore & G.C.S. Blackmore & G.C.S. Clarke, V., 1988; **41**: 45-79.
9. Perveen.A., S.Siddiqui, A.Fatima and M.Qaiser, Pollen Flora of Pakistan- I. Malvaceae. *Pak. J. Bot*., 1994; **26**(2): 421-440.
10. Saad, S. I., The sporoderm stratification in the *Malvaceae*. – Pollen Spores, 1960; **2**: 11-40.
11. Nahed El-Husseini., Pollen Morphology of Tiliaceae Juss. and Sterculiaceae Vent. and Their Relations to Malvaceae Juss. in Egypt. International Journal Of Agriculture & Biology, 2006; **8**(6):844-847.
12. 12. Perveen A. and M. Qaiser.. Pollen Flora of Pakistan-Malvaceae-Grewioideae-LII. *Pak. J.Bot*. 2007; **39**(1): 1-7.
13. Perveen,A. and M.Qaiser, Pollen flora of Pakistan-Malvaceae, Dombeyoideae-LXII . *Pak. J. Bot*., 2009; **41**(2): 491-494.
14. Nair PKK., Pollen grains of Indian plants-III, *Malvaceae and Bombacaceae Bull. Nat. Bot. Gardens*, 1962; 63:1-33 Lucknow, India.
15. Nair PKK., *Essentials of Palynology*, Asia Publishing House, Bombay 1966.
16. Nair PKK., *Pollen morphology of Angiosperms-A* historical and Phylogenetic Study, Scholar Publishing House, Lucknow, India 1970.
17. Nayar TS., Pollen flora of Maharashtra state, India, Today & Tomorrow's Publishers, New Delhi, India 1990.
18. Devarinti Srihari Reddy and A. V. B. Reddy, Palynotaxonomical Studies of Sida L. Species Belong to Nalgonda District, Telangana, India, GJRA, 2016; **5**(12): 2277-8160.
19. Lakshmi KG., Palynological studies on certain Malvales. Ph.D. thesis, Mahatma Gandhi University (India) 2003.
20. Erdtman, G., *Pollen morphology and plant taxonomy: (Angiosperms. An introduction to Palynology-I)* Almqvist and Wiksell, Stockholm, 1952; 539.
21. Erdtman G., The acetolysis method, revised description. Svensk Botanisk Tidskrskrift, 1960; **54**: 561–564.
22. Erdtman G., Pollen morphology and plant taxonomy- Angiosperms, New York 1966.

23. Erdtman G., Handbook of Palynology - An Introduction to the Study of Pollen Grains and Spores, Munksgaard, Copenhagen 1969.
24. Nair PKK., A modification in the method of pollen preparation, *J. Sci.Industr. Res.*, 1960; 19: (1) 26-27.
25. Devarinti Srihari Reddy and A. V. B. Reddy, Diversity and evolution of Pollen aperture pattern in angiosperms, Int. J. Sci. Res., 2016; **5**(12): 877-878.

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